Exploring appropriate approaches for returning research findings to communities in Ndola, Zambia

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Abstract

Many scientific research projects carried out in developing countries gather data and fail to return any summary of the findings to the community that provided the data. Residents from communities experiencing water issues are often deprived of effective participation in necessary change as they are used only as a source of data and no further involvement regarding access to research findings occurs. Indigenous writers have revealed the injustice of this reality and have suggested that this is typical of colonial research methods. This situation is a major concern because accessing research knowledge encourages communities to examine their water issues and empowers them to formulate solutions. In order to gain an in-depth understanding of residents' experiences with water research projects from communities experiencing water quality issues, and to develop an appropriate approach for returning research findings to residents, this study was carried out in Ndola, Copperbelt Province, Zambia. Inspired by decolonising methodologies, semi-structured interviews and focus group meetings were conducted in order to understand participants' experiences with water research projects. This study explores different approaches to returning research findings to participant communities using the results of a recent water research project conducted by Elizabeth Liddle in Ndola in 2013. It was found that the appropriate method for returning research findings to Ndola is face-to-face discussion, as it allows the researcher and individuals from participant communities to engage in dialogue and learn from each other while talking over the research findings from every angle, thus gaining a better understanding of their implications.

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Table of Contents

List of Figures and Tables

List of Figures

List of Tables

List of Acronyms

CWMS	Canterbury Water Management Strategy
ECAN	Environment Canterbury
GDP	Gross domestic product
JICA-MEWD	Japan International Cooperation Agency–Ministry of Energy and Water Development
KWSC	Kafubu Water and Sewerage Company
MDGs	Millennium Development Goals
MMD	Movement for Multi-Party Democracy
NGO	Non-governmental organisation
NWASCO	National Water Supply and Sanitation Council
NWSC	Nkana Water and Sewerage Company
PAR	Participatory action research
PF	Patriotic Front
SDGs	Sustainable Development Goals
UN	United Nations
UNICEF	United Nations Children's Fund
UNIP	United National Independence Party
USAID	United States Agency for International Development
USEPA	United States Environmental Protection Agency
USD	United States Dollar
WARMA	Water Resources Management Authority
WASH	Water, sanitation and hygiene
WHO	World Health Organisation

1. Introduction

According to the United Nations Children's Fund (UNICEF), in 2016 there were 783 million people worldwide lacking access to safe water, with 40 percent of these from the sub-Saharan region of Africa. This lack of access to safe water is one of the major challenges that Africa faces due to its adverse effects on public health, including diarrhoeal diseases from bacterial contamination, poor health from trace metals, and even death from toxic contaminants. Access to an adequate supply of safe water is important as water is used for many needs including domestic and industrial supply, transport, power generation, recreation, and agricultural purposes. Today governments across the world are focusing on ensuring access to clean water and sanitation for all in the next 15 years under Sustainable Development Goal number six (Harp, 2010; Sachs, 2012). In developing countries, particularly in Africa, governments face challenges including (but not limited to) provision of adequate supply of safe water, food, health services, and driving economic growth (Gray, 2008).

People often assume lack of access to safe water in African countries is due to scarcity. However, in the case of Zambia, there are abundant water resources and the issues are more ones of distribution (World Bank, 2009). Research projects about water resources are often undertaken with participants from communities, but results are not often shared with the communities. The results of these projects are the water resource knowledge produced from research and may include water quality results, water quantity information, significant concerns, and mitigation options. Lack of effective engagement of communities at all stages of water-related research projects is a major concern, because they have a basic right to have access to water resource knowledge produced from research, and without effective community involvement water resource planning may be less effective. This is evident because access to safe water in Zambia is still a challenge for about 5 million people out of a total population of more than 15 million (Water Aid, 2016).

To safeguard public well-being, affected communities have a right to access water quality information after completion of research projects. Access to information created by research projects in Africa is vital in a continent with development needs, where effective dissemination of information can be a matter of life and death (Gray, 2008). However, research projects are often conducted using methods structured in ways that benefit the researchers at the expense of participants. Several scholars (Chilisa, 2011; Tuhiwai Smith, 2012; Van Stam, 2013) state that this is oppression because researchers are reflecting and

reinforcing the domination, exploitation, and marginalisation of people who need the knowledge thus produced. Hence, they recommend using decolonising methodologies because they are community-driven and process-orientated (Chambers, 2014), with cultural protocols, values, and behaviours automatically included in the design of the research, discussion of results with participants, and disseminating results back to the people at the end of the research project (Tuhiwai Smith, 2012).

In the context of water research projects in Zambia, I suggest decolonising methodologies as the way forward in addressing access to water resource knowledge by all stakeholders, particularly local communities. To begin with, this chapter starts with brief background information about Zambia and the water resource management issues it faces, followed by the rationale to why this study was undertaken. The research aim, an introduction to community-based participatory approaches, and an outline of the thesis are also included. The chapter concludes with a summary of the water research issues being faced by local communities in Zambia.

1.1 Zambia

Zambia is a landlocked country located south of Congo and north of Zimbabwe in central-southern Africa. Lusaka, the capital and largest city, is located in the southern part of the country. The neighbouring countries are Tanzania, Malawi, Mozambique, Botswana, Namibia, and Angola (see figure 1). Zambia's unique butterfly-shaped boundary is a result of the scramble for Africa's natural resources by the Europeans in the early 1900s (Pakenham, 2015). The name Zambia is derived from the Zambezi River, which runs from the west to the southern border, forming the famed Victoria Falls and then flowing through Mozambique and finally into the Indian Ocean.

Zambia's total area is 754,000 square kilometres, the terrain is generally high plateau, with an altitude ranging from 329 to above 2,000 metres; the eastern region in particular rises up to 2,434 metres above sea level (Taylor, 2006; United Nations, 1989). Due to the high elevation, the country's climate is subtropical, although it experiences tropical conditions for most of the year. Zambia has two main seasons, the rainy season (November to April) and the dry season (May to October). The dry season is divided into the cool dry season (May to August) and the hot dry season (September and October) (Zambia Meteorological Dept., 2013; JICA-MEWD, 1995). The geographic location and subtropical climate ensure that Zambia receives high rainfall sufficient to recharge both surface and ground water resources annually (Zambia Meteorological Dept., 2013).

Figure 1: Location of Zambia in central-southern Africa. Source: *http://www.bianoti.com/gallery-zambia-map-africa.html*

In Zambia water is used for domestic, industrial, hydroelectric, transport, recreational, agricultural, cultural, and religious purposes. However, due to economic issues, the Zambian government has been facing challenges in managing the country's abundant water resources (World Bank, 2009). This is evident because there have been water shortages, intermittent supply, and water pollution incidences throughout the country. The citizens that live in poverty are the ones most affected by Zambia's water issues.

1.2 Thesis rationale

I am an African with indigenous roots that go back to the Luba-Lunda kingdom of the Bantu-speaking people of central Africa. Between the 15th and 19th centuries the Bemba tribe (my tribe), led by two of the Luba King Mukulumpe's sons, Nkole and Chiti, migrated to and settled in modern-day Zambia, particularly in the Northern and Luapula Provinces (currently the Bemba-speaking people live in other provinces throughout the country). I have a relatively clear understanding of our culture and what Zambian society expects of me morally.

1.2.1 Growing up in Zambia versus now

When I was a child, my siblings and I, in the company of older family members like uncles, aunties, and parents, would go to the community centre to watch traditional performances organised by the Department of Social Welfare. The performances, which I still consider spectacular, included drama, dancing, proverbs, or even poems. I can still remember the sound and rhythm (the beat of the drums and people singing in traditional languages) and the huge crowds that such performances would draw. In the community where I grew up such performances were a special occasion, and whenever they were at the international trade fair or the agricultural and commercial showgrounds they still drew huge crowds and people would wait for a long time just to see them. These performances had meaning and lessons embedded in them and were a great way of bringing people together for celebrations, entertainment, and the communication of messages.

When I started primary school, I admit that I would write down the names of noise-makers and people using vernacular languages (due to my role as class captain or monitor) for punishment by the teachers. We were not told why we were required to speak English in school, and one can only imagine what effect this had on me and the other pupils: in a child's mind – or to me – it seemed as if our own language was bad and we had to speak English. On one hand tradition was suppressed because speaking our language in school was forbidden while on the other it was celebrated by holding traditional performances in the communities.

Nowadays, some people consider traditional performances and culture as old-fashioned. When a person speaks a Zambian language, they are considered to have no knowledge because most people relate English with knowledge. In Zambia, a post-colonial developing country, I have experienced and observed that even after the colonisers left over 50 years ago, the majority of Zambians are still affected by the institutions and systems of the colonial culture, way of thinking, and language, still considered more developed than our own. Hence,

there is a form of internalised colonisation whereby we think less of ourselves which keeps us as colonial subjects. It is common to consider western education, realities, ideas, forms of entertainment, and language as superior. I believe that it is essential to encourage and promote the use of traditional systems – people's culture, values, ways of thinking, and language – as these are just as important as – and not inferior to – as those of the western societies.

1.2.2 Recent events

In 2013 I helped Elizabeth Liddle, a master's degree candidate from Otago University in New Zealand, to conduct fieldwork about water quality and quantity issues in Ndola, Copperbelt Province, Zambia. I was a guide in communities where data was collected, helped Liddle collect water samples and conduct questionnaire surveys, and interpreted Bemba (the local language) into English. Here I relate what happened when Elizabeth and I visited communities in Ndola.

There we were, trying to get residents to participate in Liddle's study. The response from some residents was discouraging. I could see that something was not right, especially after we told them we were conducting research about water resources: suddenly, there was a change in their utterances and expressions from welcoming to unfriendly and defensive. One old woman just got very upset and told us that *she did not want anything to do with water research*: she refused to answer questions and forbade us from collecting samples from her well and the stream flowing behind her house. I did not know why this sudden change to unfriendliness and distrust occurred, but I do know that this is one of the many memories about fieldwork that I will never forget. I wondered why some individuals refused to participate, and so I asked those who did not mind to tell me. The individuals said that *they have stopped participating in water research because they feel that they lack access to the knowledge produced after completion of research, and that they are being used merely as a source of data or as objects of study.*

In 2014, I was one of the graduate students from the Copperbelt University involved in a research project on roots, tubers, and mushrooms in Zambia. I was assigned Kalulushi town, situated in the Copperbelt Province, to conduct questionnaire surveys, and to brief and equip two colleagues who were assigned to conduct the same survey in communities in Lusaka. I received a similar response from individuals during fieldwork in communities in Kalulushi, with many individuals reluctant to participate in the roots, tubers, and mushrooms of Zambia research project. The individuals complained about being used to obtain data, saying that

after completion of research they often do not have access to the knowledge produced because it is not shared with them.

For example, I visited a workplace to conduct a questionnaire survey and only one man of around 10 employees agreed to participate. The man asked if he could say something about research before we started. I agreed, and with a concerned appearance he started with complaining about researchers: *they collect data and never share findings with participants*. He was interested in the roots, tubers, and mushrooms of Zambia research project because he enjoys drinking the traditional drink (umunkoyo) made using the roots, eating the delicious mushrooms and the traditional polony (chikanda) made from the tubers. He said that a study about the roots, tubers, and mushrooms of Zambia is long overdue and asked me to share the findings with him after completion of the study. After this experience and the one I had during Liddle's study, I realised that most individuals in communities in the Copperbelt Province are reluctant to participate in research due to past experiences with researchers who rarely share findings with participant communities or individuals. This concern is not unique to Zambia because it is a big issue in research around the world, as is evident in many peoples' reluctance to participate in research due to experiences that resulted in resentment towards researchers and mistrust of researchers (Research Ethics Guidebook, 2011).

In the case of Zambia, I suspected that there is a lack of effective engagement of communities in research projects. This is because individuals from local communities want access to the knowledge produced by researchers after completion of water research projects, but it is often not shared with them. I argue that local communities have a right and need access to knowledge produced by researchers about water resources to have improved access to safe water. Unequal access to safe water is one of the challenges being faced in water resource management in Zambia, with only 67.7 percent of the population having such access (Central Statistical Office, 2015).

The people that have consistently been excluded from water services include those living in poverty and residents from informal and rural communities. Women, children, and other vulnerable groups, particularly those living in poverty, are affected the most (End Water Poverty & VAREN, 2015). In urban areas commercialisation of water has created affordability challenges for people living in poverty and has affected their ability to access water (Water Aid, 2016). Lack of access to safe water is a major factor that contributes to

increased poverty in Zambia, particularly in the rural areas (African Development Fund, 2006).

I argue that unequal access to safe water occurs because local communities do not have access to water resource knowledge produced from research projects. Therefore, this study's hypothesis is: *There is unequal access to scientific knowledge about water quality by local communities in Zambia.* Access to scientific knowledge by local communities allows for mitigation efforts to be directed towards the right issues and is more likely to have maximum impact (Research Ethics Guidebook, 2011). Hence, the question that I want to answer in this study is: *What method is appropriate for returning water quality results to communities in Ndola, Copperbelt Province, Zambia?* To answer this question, I examined different methods that have been used internationally to return research findings to local participants.

1.3 Research aim

The aim of this research is to examine appropriate methods for returning research findings to communities facing water quality issues in Ndola, Copperbelt Province, Zambia. To accomplish this, specific objectives where undertaken. The overall objective of this study was to review international practice for returning data to communities and to experiment with using one or some of these to bring back data from the water quality project carried out by Liddle in Ndola in 2013. Therefore, the specific research objectives were as follows:

1. Review Liddle's research findings, key documents about water resources (government reports and policies, reports from non-governmental organisations (NGOs) and universities), and literature about inequality in research and the different approaches used by researchers to return findings to communities.
2. Conduct semi-structured interviews with individuals who have participated in water research projects, so as to get an in-depth understanding of their experiences. These include key informants from the Kabushi Water and Sewerage Company (KWSC) and the NGO Seeds of Hope, and individuals from Kabushi, Nkwazi, and Kaniki communities.
3. Conduct focus group meetings with individuals who participated in Liddle's study in 2013 from Kabushi, Nkwazi, and Kaniki communities.
4. Develop principles for taking back research findings to communities with water issues in Zambia.
5. Make recommendations to improve water resource management in Zambia.

To achieve the aim of this study, I conducted semi-structured interviews with key informants and residents from participant communities to get a deeper understanding of their experience with water research projects. I also shared research findings with focus group participants from communities whose water quality results were poor based on Liddle's study in Ndola in 2013. I shared water quality results, significant concerns, and mitigation options with the affected communities using video, presentation, brochure and discussion methods. Engaging communities by taking in their perspective and sharing research findings allows for effective participation (Chambers, 2014), and can promote trust and encourage collaborative efforts in addressing poor water quality issues being faced in Ndola.

Not only are water quality issues based on theoretical or scientific principles, they also involve varying practical and societal contexts (Bauer, Allum & Miller, 2007; Sturgis & Allum, 2004). Research that is participatory alone fails to fully address issues regarding the background and culture of the participant community and ownership of knowledge produced from research. Hence, I used decolonising methodologies to ensure effective engagement, and empowerment of local communities to encourage self-determination. This was achievable because decolonising methodologies encourage and promote equality in research as they use equal power structures and are not based on Euro-western paradigms (Chilisa, 2011; Tuhiwai Smith, 2012).

Liddle herself also recommends the use of a community-based participatory approach to ensure significant outcomes such as improved access to safe water in Ndola, where there is a need for water providers and water experts to increase engagement with local communities. For example, a community-based participatory approach was used in New Zealand. The Canterbury region over the last decade has seen a significant increase in pressure (rapid increase in demand for water) on its water resources, leading to the rise of an adversarial approach in water resource management and freshwater degradation from related land management practices (Jenkins, 2007). The region has been experiencing water issues including decline in water quality, reduced amount of reliable water for farming and energy use, and loss of recreational use and cultural value (Environment Canterbury, 2016). To address these water issues the Canterbury Water Management Strategy (CWMS) was developed, to allow for a balance between developing the economy and protecting and improving the environment. To achieve this, a collaborative framework was used to sustainably address the water issues in Canterbury.

The CWMS is based on community discussions which were held over several years. The meetings were led by Environment Canterbury, Ngāi Tahu (the Māori tribe of the southern region of New Zealand), and Canterbury's district and city councils (Durette et al., 2009; Environment Canterbury, 2016). The Māori have a cultural connection with freshwater resources: "when the water is healthy, the land and the people are nourished" (Kei te ora te wai, kei te ora te whenua, kei te ora te tāngata). Hence, their role as kaitiaki (guardians of an environmental area or resource) when managing water resources is legally recognised in New Zealand legislation and policy (Durette et al., 2009). This is because it is essential to not only consider or recognise but also account for Māori values in water resource management. From the meetings in each of the 10 zones the representative stakeholders from the communities had access to scientific knowledge about water resource issues to enable them to make informed decisions regarding the best approach for managing water to meet the set targets and milestones.

The collaborative approach encouraged people to be involved in decision-making; as a result, many individuals in these zones will use the land and water based on the policy changes and recommendations (Environment Canterbury, 2016). The collaborative and integrated management of the CWMS was developed to address the water issues and allows for the greatest, economic, recreational, cultural, and social benefits from water resources within a framework that is environmentally sustainable for present and future generations (Environment Canterbury, 2012). The quality of water will be protected, thus ensuring protection of human health while protecting and restoring the ecosystems, leading to significant improvement of indigenous biodiversity. However, there are still issues and controversies that the Māori are concerned about; furthermore commercial and residential users differ in their views regarding water use and management.

1.4 Thesis outline

A detailed account of Zambia's water resources and management issues based on scientific, governmental, and citzen knowledge is provided in Chapter 2. Chapter 3 is a review of the literature; it introduces the overarching theory used in this study, that of conflict theory, and approaches that can be used to achieve communities' effective participation, particularly access to knowledge produced in research. Chapter 4 gives an overview of Liddle's research findings and outlines in detail the ethical considerations at play, as well as the decolonising methodologies used in this study, which are indigenous methodologies and Freire's framework. Also included are the methods used to share the research findings with communities that participated in Liddle's study in Ndola in 2013, and an outline of how the data collected from the field was analysed is provided. Chapter 5 presents experiences of individuals with water research and the method (face-to-face discussion) that the communities preferred for sharing research findings. Chapter 6 is a discussion of the key themes in communities' participation in research projects, based on existing literature. Chapter 7 is a summary of the study's key findings, gives an overview of how the objectives were achieved, and gives recommendations for future research projects and water resource management in Zambia. Appendices containing the human ethics application, information sheet, oral information script, consent form, oral consent script, research assistant confidentiality form, brochures, focus group presentation, and discussion notes are provided.

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Zambia has abundant water resources, but the government faces many challenges, including but not limited to challenges in providing adequate safe water to about 5 million people (World Bank, 2009; Water Aid, 2016). I argue that water resource management may be ineffective because effective involvement of local communities in water issues in Zambia is rare, particularly access to water resource knowledge. The knowledge produced from water research can be used by both experts and local communities to address the water resource management issues being faced in Zambia. However, researchers often undertake water projects with participants from local communities where the knowledge produced is often not shared with those communities. Methods that deprive local communities' effective participation are identified as colonial research methods (Chilisa, 2011). Such methods reflect and reinforce domination, exploitation, and marginalisation of knowledge from participants that helped produce it.

2. Water resource management in Zambia

2.1 Introduction

Water research projects have been a feature of the Zambian scientific landscape for a long time, both before and after independence in 1964. Participants include individuals from urban and rural communities. The knowledge produced in these scientific research projects could assist communities to avoid, detect, or identify health threats (Weigold, 2001), thus there is high community interest in science communication. Communities need access to scientific information in order to understand and better comply with policies, which are generally set based on scientific findings (Ziman, 1992).

However, the knowledge produced from studies after the completion of research projects is often not communicated with the communities who participated in the studies. Access to knowledge produced from research projects at the community level is not done with the urgency it requires, as I observed when I was working as a research assistant in the Copperbelt Province. If information that is essential to communities facing poor water challenges is not communicated, then weak or failing development programmes will continue to occur (Erskine Childers, cited in Mulale et al., 2013, pg. 153). This is because failure to provide feedback to participants can cause problems for future researchers as communities are made to feel that they are just being used, leading them to mistrust researchers and be more reluctant to participate in research (Research Ethics Guidebook, 2011). Clearly this situation is not beneficial for the effective management of water resources. To address this issue researchers must be encouraged to share knowledge produced from research projects; in fact they must be reminded of their ethical responsibility and the rights of participants.

This chapter gives a detailed explanation of water resource issues in Zambia. It highlights what the researchers (scientific research projects), government (policy), non-governmental organisations (NGOs), and citizens (local communities) already know about water resources in Zambia. This will give some foundation or better understanding of the past and present situation in Zambia. To achieve this, a detailed outline of Zambia's administrative history, its water resources, management of these resources, and the people in relation to use and access to adequate safe water is included.

2.2 Zambia's administrative history

Zambia's administrative history is partly defined by minerals and water resources. In 1902, minerals were discovered in the central region of Northern Rhodesia with zinc and lead found in Broken Hill (now Kabwe), and in 1909 vast mineral wealth was discovered on the border between Belgian Congo (now Democratic Republic of Congo) and Northern Rhodesia (now Zambia) (Gascoigne, 2001). This region was called the Copperbelt, as it contained the largest reserves of copper in the world outside the American continent. Due to the discovery of these minerals, occupation of southern Africa by the British started in the 19th century (Van Zyl, 1971). Cecil Rhodes was the driving force behind British colonial expansion in Africa, in 1889 forming the British South Africa Company. Although the company's administration was handed over to the British government in 1924, Rhodes was permitted to retain mineral rights (Gascoigne, 2001). This increased European involvement in Northern Rhodesia, which become a Crown protectorate, and in 1924 the exploitation of the Copperbelt began.

The Copperbelt region was originally merged as part of the Federation of Rhodesia and Nyasaland (now Malawi) but later became an independent colony with its own assembly and prime minister (Gascoigne, 2001), initially Lord Malvern, and after 1956 Mr Roy Welensky. In 1960, Kenneth Kaunda, president of the United National Independence Party (UNIP), was acknowledged by British authorities as the primary political voice of the majority African population in Northern Rhodesia (Gascoigne, 2001). In 1964, after the dissolution of the federation, elections were held; UNIP won with a clear majority and got 30% of the European vote. Hence, Kenneth Kaunda became the first president of a new nation called Zambia, which he governed up to three decades under a one-party state (Gascoigne, 2001). Zambia's economy grew in the early 1960s (eve of independence), which put Zambia in the position of one of the richest of Africa's emergent post-colonial countries (Taylor, 2006). In the late 1990s, the economy grew by an average of 5% to 6% in the gross domestic product (GDP). This was the case over several years due to the rise in copper prices and sound macro-economic policies which led to significant macro-level performance (USAID, 2011). However, this contradicted the reality being experienced by most Zambians (poverty was and still is a significant problem).

After the change to a multi-party state, the Movement for Multi-party Democracy (MMD) under the leadership of Fredrick Chiluba won the elections in 1991. During this period the Zambian government was pressured by the World Bank and the International Monetary Fund to privatise the mining industry, and the industry was completely privatised by 2001

(Osborne, 2012). The MMD party governed Zambia under changing leadership over the years until 2012 when the Patriotic Front (PF) party won the elections under the leadership of Michael Sata, who died in office. Currently Edgar Lungu, under the PF party, is the president of the Republic of Zambia. More recently Zambia's economy has endured the effects of a decline in world copper prices over the years and the global economic crisis, where a rise in unemployment levels, high inflation, currency instability, and limited access to capital diminished its economic performance (U.S. Department of State, 2012). The current government has been facing many challenges, including (but not limited to) driving economic growth and provision of an adequate supply of safe water, food, and health services to many citizens (Gray, 2008).

Zambia's administrative history shows that the mining industry has been Zambia's economic backbone and that Zambia has experienced peace and stability since independence. This is clearly not enough, as poverty is still a huge problem. Zambia's economy has endured the effects of falling world copper prices and the global economic crunch. Many Zambians have been facing challenges in having access to health services, food, and safe water (USAID, 2011). As former Mines and Mineral Development Minister Wylbur Simuusa said, "We are wealthy yet we are poor": the people have been denied much of the profit from the abundant reserves of natural resources before independence and after privatisation of the mining industry (Osborne, 2012). To address poverty, Moyo (2009) suggests official development assistance and opposes humanitarian aid because it maintains poverty and impedes economic growth. Official development assistance is more desirable and beneficial for the effective management of water resources in Zambia. Moyo (2009) further argues that humanitarian aid to African governments has cultivated dependency and encouraged corruption; this eventually perpetuates poor governance and poverty.

2.3 Water resources in Zambia

Access to safe water is among the many challenges that are being faced in water resource management in Zambia. I will attempt to present this fact in this section, which begins with an overview of the country's water use history, followed by a scientific account of the water resources available, water resource management, and the challenges faced in providing communities with water in Zambia. From independence in 1964 to the mid-1970s, Zambia experienced an infrastructure boom, during which most of the treatment and distribution infrastructure for water was built (WHO & UNICEF, 2015). This occurred because during this period, there was strong economic growth and high export earnings from copper mining.

The local authorities were responsible for domestic water supply in urban areas except for the Copperbelt Province where water was provided by the state-owned copper production company. However, the few residents that had access to continuous supply received water for free, which often resulted in wastage. In the late 1990s local authorities (the city of Lusaka, followed by Chipata) started charging water tariffs, and after the privatisation of copper production companies (mines) in 2001, commercial water supply was also carried out by local governments, through the city councils in the Copperbelt Province (Dagdeviren, 2008).

Several years later the water treatment plants and distribution network infrastructure became dilapidated due to maintenance issues, which led to severe water shortages and irregular supply (Dagdeviren, 2008). In 2000, regional commercial water utilities companies, a regulatory agency called the National Water Supply and Sanitation Council (NWASCO), and the Devolution Trust Fund were established. The Devolution Trust Fund focused on supporting people living in poverty, particularly in peri-urban areas, and on increasing access to water supply in rural areas (Dagdeviren, 2008). Communal water taps and standpipes where provided for residents without distribution infrastructure to have access to water for domestic needs, but they still experienced challenges as the supply was irregular. In 2004 water kiosks where introduced as pilot projects in informal settlements and areas with intermittent water supply. However due to cost of buying water and the irregularity of the water supply from the kiosks, many residents from informal communities reverted to hand-dug shallow wells and rivers as water sources (Dagdeviren, 2008).

The water shortages experienced in the Copperbelt Province in Zambia in the past years were not due to insufficient quantities of water, since the Kafue River (source of domestic water) normally flows with adequate volumes year after year. The water shortages were a result of ineffective management by water utility companies that had deteriorated and insufficient infrastructure capacity as well as resources to provide domestic water to a rapidly growing population (Dagdeviren, 2008). Rapid population growth should not be a major issue; Zambia has abundant water resources because it is located in a high rainfall region (JICA-MEWD, 1995). During the rainy season rainfall varies between 500 and 1,400 milimetres per year, with most regions receiving between 700 to 1,200 milimetres: for example, the average rainfall in the Copperbelt Province is 1,231 milimetres per year, which is equal to 43,287,561,050 cubic metres per year. The estimated evapo-transpiration for the Copperbelt Province is 891milimetres per year, which is equal to 31,331,614,050 cubic metres per year (JICA-MEWD, 1995).

The high rainfall received in the region recharges surface and groundwater resources annually (JICA-MEWD, 1995). Both surface and groundwater is generally of good quality and is contributed by the Zambezi and Congo River Basins (see Figure 2 and Table 1).

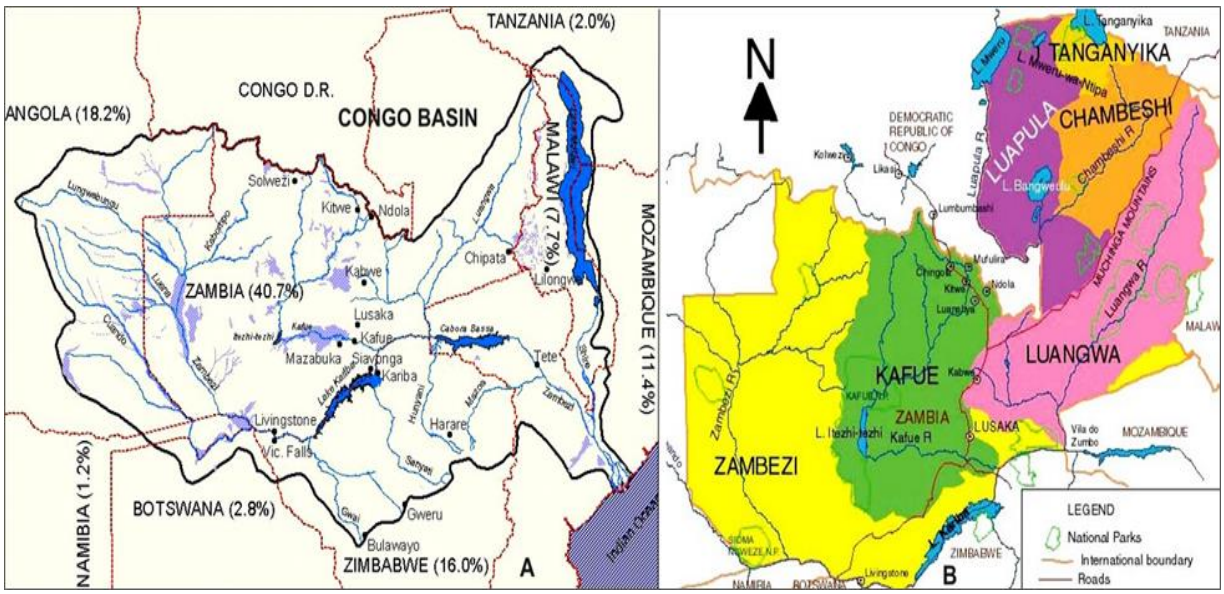

Figure 2: (A) the Zambezi and Congo River basins, and (B) the Zambezi River Basin (sub-basins in Zambia). Source: JICA-MEWD, 1995.

Table 1: Length, per cent contribution to surface water potential, annual runoff and area for each sub-basin. Source: JICA-MEWD, 1995.

Sub-Basin	Length in Zambia (km)	Basin area (km^2)			% contribution to surface water potential	Annual runoff (km^3)
		Total	In Zambia	Outside Zambia		
Zambezi	1,700	687,049	268,235	418,814	36.36	41.75
Kafue	1,300	156,995	156,995	-	8.40	9.88
Luangwa	850	147,622	144,358	3,264	19.44	22.32
Chambeshi	560	44,427	44,427	-	7.62	8.75
Luapula	615	173,396	113,323	60,073	26.25	30.14
Lake Tanganyika	250	249,000	15,856	233,144	1.73	1.99
Total	**5,272**	**1,458,489**	**743,194**	**715,295**	**99.8**	**114.83**

The freshwater bioregion, including rivers, lakes, and complex wetlands, indicates that there is abundant water in the Zambezi River Basin (Thieme et al., 2005). Zambia has several large rivers, including the Zambezi, Kafue, Luangwa, Chambeshi, and Luapula rivers. It also has several large freshwater lakes, for example Lake Kariba, Lake Tanganyika, Lake Bangweulu, and Lake Mweru. The major rivers and lakes hold most of the surface water in Zambia (Figure 2 and Table 1). 40.7 percent (largest percentage) of the Zambezi River Basin is in Zambia, covering three-quarters of the country, followed by Angola with 18.2 percent and Zimbabwe with 16.0 percent, with the rest in Mozambique, Botswana, Malawi, Tanzania, and Namibia. The Zambezi River Basin is divided into smaller sub-basins (Figure 2, B). The Zambezi River contributes the country's largest surface water potential (36.36 percent), followed by Luapula River with 26.25 percent (Table 1).

The presence of rock systems indicates the presence of groundwater in Zambia. The geology is dominated by crystalline rocks, although a sequence of sedimentary rocks occurs in some regions (United Nations, 1989). The four main types of aquifers (permeable rocks) which hold groundwater are shown in Figure 3: the Katanga (upper and lower Roan), Basement, Karoo, and Muva (alluvial) systems (JICA-MEWD, 1995). The Katanga System is comprised of metamorphosed sediments including shales, dolomites, sandstone, limestone quartzites, and conglomerates (British Geological Survey, 2001; Nonde, 2012).

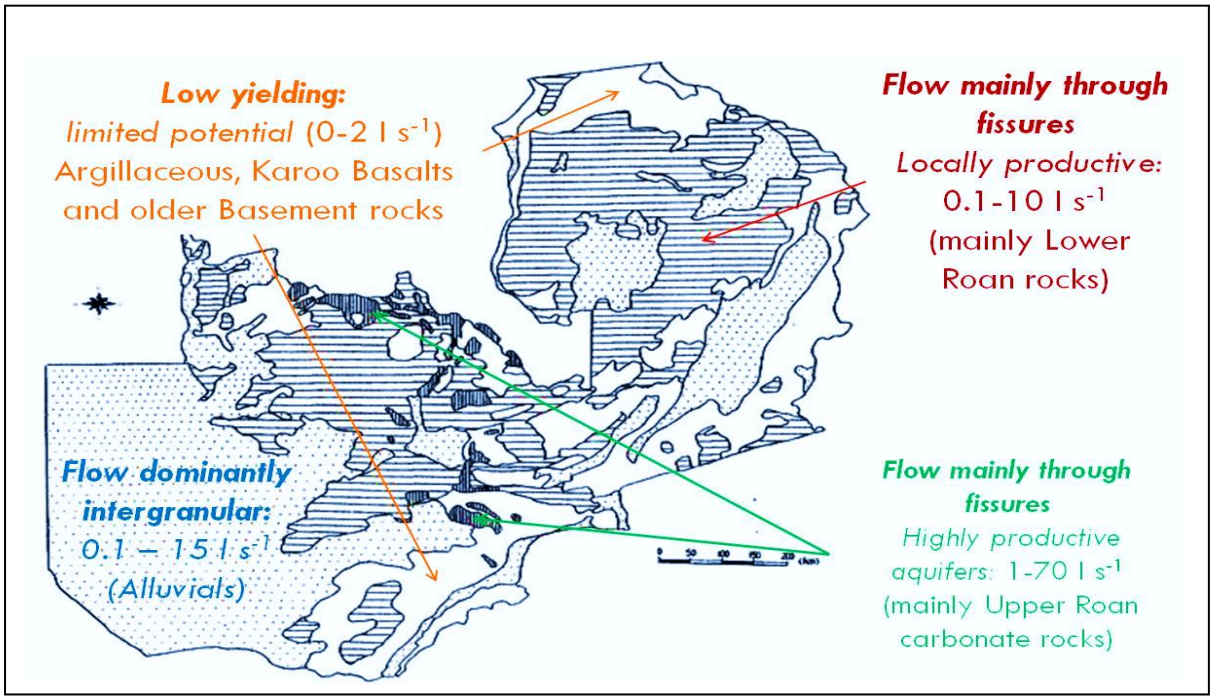

Figure 3: Map of Zambia showing the three main types of aquifers (Source: National Water Resources Master Plan for Zambia, JICA-MEWD, 1995).

According to Njuguna et al. (2003), Zambia has around 1,740 cubic kilometres of groundwater resources with an annual recharge rate of 160 cubic kilometres; hence, the United Nations (2009) estimates the groundwater potential to be around 49.6 cubic kilometres. For example, in the Copperbelt Province, particularly in the upper Kafue catchment, the groundwater level rises on average 2.5 metres from low to high groundwater level (AHC–Mining Municipal Services Ltd., 2004). This is based on an average specific yield of the Katanga aquifer in the Copperbelt Province. The 2.5-metre increase in level is equal to an increase in water volume of 2,200,000,000 cubic metres per year – the recharge to the groundwater resources in this region.

According to Lambert (1965), rocks of the Katanga age possess the highest groundwater potential as a single geological sequence occupying the northern and central parts of Zambia. The Lower Katanga dolomite is by far the most important aquifer owing to its yield characteristics (Lambert, 1965; Nonde, 2012). Nyambe and Feilberg (2009) state that groundwater in the Katanga system occurs in structures that generally range from 30 to 40 metres in depth within merged hard rocks and often extend to over 90 metres deep. The Katanga aquifer has been divided based on yields – the highly productive, locally productive, and low yielding aquifers.

The highly productive and locally productive aquifers hold more water compared to the low yielding aquifers, which have yields of 0-2 litres per second. The highly productive aquifers have yields ranging from 1 to 70 litres per second (Nyambe & Feilberg, 2009), and recently Nonde (2012) recorded yields ranging from 20 to more than 100 litres per second. These aquifers are comprised of Upper Roan dolomite and Kundelungu limestone. However, they have limited and very narrow areas of distribution as they are located in the Copperbelt, Lusaka, North-Western and Central provinces. The locally productive aquifers have yields ranging from 0.1 to 10 litres per second (Nyambe & Feilberg, 2009). These aquifers comprise Lower Roan quartzite, Muva sediments, granites, and undifferentiated Kundelungu structures spread mostly in Northern, Luapula, Central, North-Western, and Copperbelt Province.

In 2005 the water resource potential was estimated at 186.65 cubic kilometres for Zambia. Therefore, the water resource was sufficient to meet actual demand, which was estimated at 40 cubic kilometres for 11.7 million people, and also the future demand of a growing population, which is currently at 14.5 million. Records show that the total water extraction in Zambia in 2008 was 38.5 cubic kilometres. The hydroelectric generation sector used 36.3

cubic kilometres, the agriculture sector used 1.8 cubic kilometres, while industrial and municipal activities claimed 0.4 cubic kilometres (United Nations, 2009). On the other hand, climate change will make a significant contribution towards increase in variability because it has an impact on the water ecosystems as a few regions in Zambia will either experience an increase in water stress or floods (Kampata, 2010; Njuguna et al., 2003).

What I have tried to show in this section is that Zambia has abundant water resources that can be extracted for use by different sectors and still have ample quantities of water in the entire basin area (Nkhuwa, Mweemba & Kabika, 2013). The rivers in the basin area will still maintain their environmental flow to perform ecological services (sustain freshwater ecosystems). For example, Njuguna et al. (2003) state that Zambia has a renewable water resource of around 10,000 cubic metres per person annually, expected to reduce to about 6,000 cubic metres by 2025. Zambia is therefore not currently threatened by water scarcity.

2.4 Uses of water in Zambia

Zambia has a population of 15,473,905, with a population density of 21.9 inhabitants per square kilometres (Central Statistical Office, 2015). About 42% of the population lives in urban areas. The Copperbelt Province, as shown in Figure 4, has an area of 31,328 square kilometres with a population of 2,362,207 and a density of 62.5 inhabitants per square kilometre.

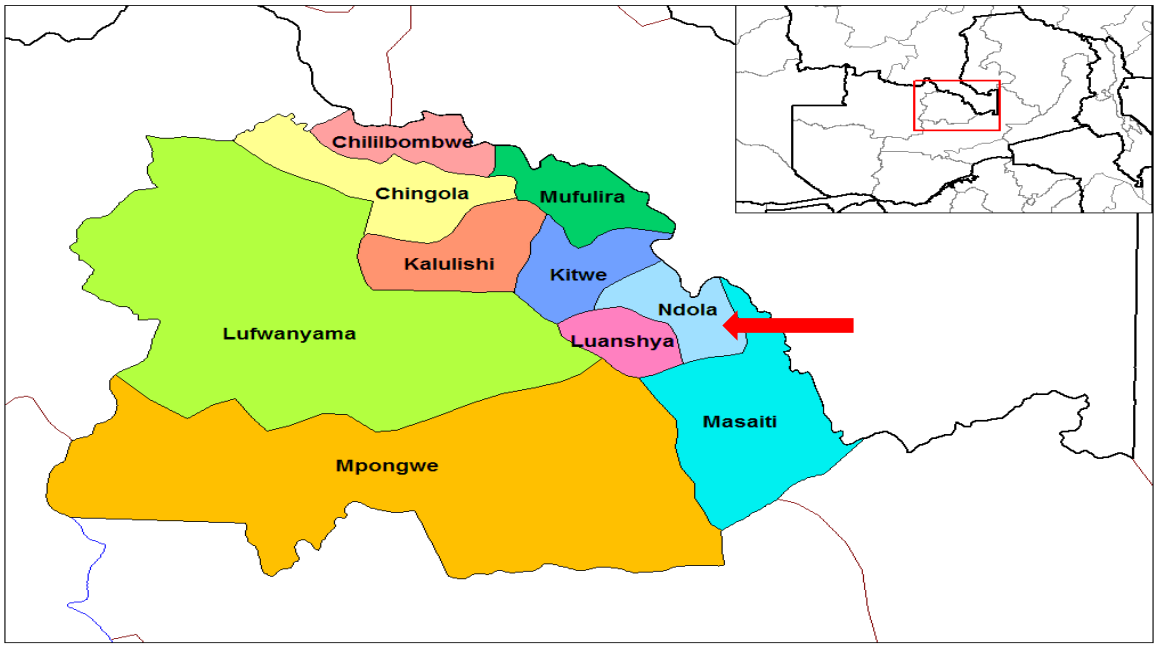

Figure 4: Location of Ndola in the Copperbelt Province. Source: https://commons.wikimedia.org/wiki/File:Copperbelt_districts.png#/media

Ndola (the study area) is an urban area located in the Copperbelt Province with an area of 1,103 square kilometres, a population of 530,129, and a density of 490.4 inhabitants per square kilometre. Zambians use water for domestic and industrial needs and for hydroelectric production, transport, recreation, and agricultural purposes. In rural areas, most families rely on subsistence farming to survive and sell excess produce to support themselves, while people that live near the lakes depend on fishing for a living; however in urban areas, various types of jobs support most people (Reynolds, 1993; Stromgaard, 1985).

Access to water for cultural and religious purposes is important in Zambia. Water plays a vital role in cultural practices and religious beliefs: it is used in cultural practises to purify objects for rituals (Water Policy International, n.d.). Many people believe that spirits live in holy places which include water bodies (rivers, lakes, waterfalls), big trees, mountains, and graves (Schech & Haggis, 2000). Rivers are used as a means of transport during traditional ceremonies. For example, the Kuomboka ceremony is the movement of the Lozi people in the rainy season from the Barotse plains using canoes to travel down the Zambezi River with the Litunga (chief) leading the way to higher ground (Muimu, 2012). The Lozi people that inhabit the Barotse plains are compelled to move once a year because floods invade and creep across the villages and pastures.

Zambia is made up of 73 tribes, each with its own dialects and language, living together mostly in peace (Taylor, 2006). This united identity is emphasised by the One Zambia One Nation slogan, a strong symbol introduced by the first president, Kenneth Kaunda. The main tribes are the Bemba, Nagoni, Tonga, Lozi, Chewa, Tumbuka, Lunda, Luvale, and Chokwe. About 97% of the population is from the 73 tribes while the rest are of of European, Asian, or Indian descent or from other African countries. There has been a large influx of refugees from border countries escaping conflicts such as those in Angola and the Democratic Republic of the Congo. Tribal languages are used throughout Zambia, where Bemba, Lozi, Luanda, Luvale, Nyanja, Tonga, and Tumbuka are the main vernacular languages spoken. In Zambia, each tribe has its own culture: culture is important in that it preserves the customs, identity, and beliefs of a tribe, and is passed on using oral forms, still practised today (Taylor, 2006). For example, showing respect to elders is an important aspect of Zambian culture, and so when greeting an elder, respect is shown by either kneeling or bowing one's head and saying terms that signify respect. This varies depending on the particular tribe: the various tribes have various ceremonies (rituals), including funerals, initiations, weddings, and other traditional ceremonies which involve plenty of food and beer prepared traditionally.

Like culture, religion is equally important in Zambia. Zambia is a Christian nation since its official declaration as such by Frederick Chiluba, the second president of the republic of Zambia, on 29th December 1991: 87% of the population are Christians while 1% is Muslim or Hindu and 12% have Indigenous and other beliefs (U.S. Department of State, 2010). In religious practices, water is used for baptisms (a public declaration of a person's belief and faith in Christ Jesus) because it cleanses spiritually (Water Policy International, n.d.). Water is also used by individuals to wash externally, in preparation to come into a place of worship. I have attempted to show that in Zambia, water is vital for domestic, industrial, hydroelectric generation, transport, recreation, agricultural, cultural, and religious purposes. However, there are several challenges in water resource management in Zambia; for example, access to safe water is among the many challenges being faced by many people (Water Aid, 2016).

2.5 Water resource management in Zambia

This section gives an overview of how water resources are managed; it also includes the challenges faced by the Zambian government in managing water resources, and the challenges and differences in water supply or sources between the urban and rural areas. This information will reflect the government and communities' standpoint about water resource issues in Zambia.

2.5.1 Governance of water resources

Private ownership of water is not recognised in Zambia except in a unique situation where the whole tribe owns the water (Phiri, 2000). This is because Zambian law recognises customary or traditional rights and interests, and customary law puts emphasis on community rather than individual interests. The supreme law on water resource management in Zambia was the Water Act of 1948, which stipulated issues regarding ownership of water, consent procedures, and cancellation of its use (Phiri, 2000). However, the Water Act lacked a guiding policy, which resulted in gaps and duplication of efforts in managing water. As a result, in 1994 the Zambian government adopted the National Water Policy, with the aim of providing a holistic approach in managing the water sector. The National Water Policy was revised in 2010 and is the main policy document that provides principles to deal with water resource management in Zambia (Nyambe & Feilberg, 2009). Other pieces of legislation that support this document are the Water Act of 1948, the Environmental Protection and Pollution Control Act of 1990, the Public Health Act of 1995, the Local Government Act of 1991, the Water Supply and Sanitation Act of 1997, and the Water Resources Management Act of 2011.

The Water Supply and Sanitation Act of 1997 established the National Water Supply and Sanitation Council (NWASCO) with the role of providing efficient, sustainable water and sanitation utilities and the authority to do so. NWASCO is an independent regulator and was established to implement the National Water Policy and the Water Supply and Sanitation Act (Phiri, 2000). Implementation of the policies is being achieved by setting standards and benchmarks, summarising tools for regulation, analysing information, and dealing with licensing and subsidies. The aim of the Water Supply and Sanitation Act of 1997 is to improve productivity and hence quality of life for all citizens by ensuring equal provision of an adequate, sustainable amount of safe water at a reasonable price. Control over all water resources in Zambia is exercised by the Water Resources Management Authority (WARMA). WARMA is an independent statutory body established under the Water Resources Management Act of 2011 with the mandate of preserving and protecting water resources in Zambia. This is done via regulation of abstraction, allocation, use, development, and management of water resources in a sustainable manner.

2.5.2 Water resource management challenges

The Zambian government has been facing many challenges in providing safe water to many people – about five million people lack access to safe water (Water Aid, 2016). This is because the water sources are unsafe, particularly in informal and rural communities where hand-dug shallow wells and waterways are the main sources of domestic water. Even residents in urban areas often complain about poor service (irregular supply and water shortages) (World Bank, 2014). There is a huge difference in access to a safe water supply between urban and rural communities in Zambia, as shown in Table 2.

Table 2: Access to a safe water supply in Zambia in 2015. Source: Modified from Central Statistical Office (2015).

2015	**Population**	**Distribution of population (%)**	**Access to water based on coverage (%)**	**Population with access to safe water**	**Population without access to safe water**
Zambia	15,473,905	-	67.7	10,475,834	4,998,071
Urban	6,499,040	42	89.2	5,797,144	701,896
Rural	8,974,865	58	51.6	4,631,030	4,343,834

In the urban areas 5,797,144 people have access to safe water and 701,896 people do not. In the rural areas 4,631,030 people have access to safe water and 4,343,834 people do not. The total population in Zambia (urban and rural residents) without access to safe water is 4,998,071 (Central Statistical Office, 2015). For example, in the Copperbelt Province the water quality has been degraded due to the pollution of domestic water sources (surface and groundwater) from industrial, mining, and sewage effluents from urban areas and pit latrines or septic tanks from rural areas (Njuguna et al., 2003; NWASCO, 2010). Several reports by water quality experts have revealed high concentrations (above the WHO's maximum acceptable values) of metals and faecal coliforms in some of the waterways and wells used as domestic water sources by individuals, particularly in informal and rural communities. This is a major concern because waterborne diseases such as diarrhoea claimed about 13,700 lives in 2004 (USAID, n.d.). More than 1,000 children under the age of five die from diarrhoea annually, owing to the use of unsafe water and poor sanitation in Zambia (Water Aid, 2016).

To respond to these challenges, the water and sanitation vision is "to promote sustainable water resources development and sanitation with a view to facilitating an equitable provision of adequate quantity and quality for all users at acceptable costs and ensuring security of supply under varying conditions" (Phiri, 2000, p. 4). This will improve water resource management and significantly contribute to the attainment of the United Nations (UN's) Sustainable Development Goals.

2.5.3. UN's Sustainable Development Goals in water resource management

World leaders vowed to eradicate extreme poverty globally by 2015, and this was to be achieved via attainment of the Millennium Development Goals (MDGs) (Food & Agriculture Organization, 2005). One of the aims involved reducing the number of people without sustainable access to safe drinking water by half. Some advances were made in achieving the MDGs; however, in sub-Saharan Africa advances have been slower than other regions worldwide (Millennium Ecosystem Assessment, 2005). In 2015, the period for attaining the MDGs came to an end and the post-2015 agenda was agreed on. This is comprised of 17 Sustainable Development Goals (SDGs) (Sachs, 2012). The sixth one centres on ensuring access to clean water and sanitation for all in the next 15 years.

The pledge to reduce poverty will be achieved by improving people's health, agriculture, infrastructure, and education. Access to safe drinking water plays a significant part in all these goals. This is because a reliable source of safe water meets basic human needs and so is required to eliminate poverty, which leads to attainment of sustainable development (Harp,

2010). Therefore, African leaders have committed themselves to ensuring sustainable access to adequate supplies of safe water and sanitation, particularly for the people living in poverty (Nyambe & Feilberg, 2009). Furthermore, there are several international NGOs in Africa which are helping governments by focusing on providing reliable safe sources of water for communities in need (particularly people living in poverty). I will now consider Non-governmental organisations **(**NGOs') involvement in water resource issues.

2.5.4 NGOs and water resource management

The NGOs involved in water resource management issues and provision in Zambia include World Vision, Village Water Zambia, Seeds of Hope, Water Partnership, Water Aid, Care International, SNV, and the Zambia NGO WASH Forum.

Most of the NGOs are focused towards the rural water sector because communities in rural areas lack adequate supply of safe water and are victims of unequal allocation of water resources due to their remote locations and the absence of water distribution infrastructure in rural locations (Musonda, 2009). There has been a lack of coordination between the NGOs, ministries, and funding agencies, which has led to absence of integrated development efforts in the water supply and sanitation sector. However, most of the NGOs are very proactive, as is evident through their good work in Zambian communities. For example, Seeds of Hope has been involved with assisting communities in getting access to safe water by providing biosand filters to households whose domestic water sources are wells and waterways (informal and rural communities). Information about water and sanitation hygiene is also shared with the communities. In the urban areas, portable water is supplied to households by commercial utilities and private schemes (NWASCO, 2011). I will now discuss the provision of portable water in urban areas.

2.5.5 Provision of potable water in Zambia

The industrial and municipal sectors are provided with water via 11 commercial utilities and 7 private schemes (NWASCO, 2011). Local authorities run the commercial utilities, which provide water services to over 86% of the urban population. The commercial utilities are regulated by NWASCO and are obliged to provide safe water and sanitation services to residents in Zambia (United Nations, 2009). In suburban areas, the portable water supplied to residents is metred. At the end of the month the water bill reflects the volume of water used. Tariffs for domestic consumption is from USD 0.38 per 0 to 6 cubic metres of water, commercial consumption is USD 0.83 per 60 cubic metres of water, and in areas without water metres the residents pay USD 7.00 (fixed amount) every month. The same applies to

informal settlements, but in areas without a piped network system for water supply, residents buy portable water from kiosks for USD 0.42 per cubic metre.

The commercial water utility companies experience challenges in providing adequate safe water to communities (NWASCO, 2010). The challenges include degrading water quality, increase in water demand, timely maintenance of infrastructure, and the urbanisation rate exceeding infrastructure development (Nkhuwa et al., 2013). The groundwater source is often at risk of bacterial contamination from the increasing number of shallow wells and pit latrines used by residents in informal settlements as they are poorly constructed and lack adequate sanitary seals. In remote areas, septic tanks (soakaway) are a probable source of bacterial contamination, while the herbicides, pesticides, and fertilisers used in agriculture may pollute the surface water through runoff and the groundwater system through seepage (Sracek et al., 2010). The wastewater discharged from manufacturing industries and domestic activities contains chemicals which can pollute rivers (Nyambe, Kribek & Majer, 2002). As a result, treating water for domestic supply within the Zambia Bureau of Standards as required by NWASCO is challenging and costly for the commercial water utility companies.

For example, according to a water quality expert from Kafubu Water and Sewerage Company, "The water quality issues we face include bacteria and nutrients (nitrates and phosphates) contaminating our water sources. Groundwater is being polluted by pit latrines and septic tanks set up without regulation. It is becoming more expensive to treat groundwater. The recycled water (from Kafubu River) is very expensive to treat as we require more money to buy chlorine and other chemicals to treat water to the standards set for domestic use."

The Copperbelt Province in particular has water quality issues because the Kafue River, the main source of domestic water, is used as a sink for industrial, mining, and sewage effluents from urban areas (Njuguna et al., 2003). The mining industries in the Copperbelt Province use large quantities of water in mineral extraction and production processes. In 1995 it was estimated that 40% of the water in the upper Kafue River originated from the Konkola mine (Pettersson, 1999). Effluents containing chemicals, minerals, and metals have been released into the Kafue River and groundwater systems through seepage, polluting the freshwater ecosystem. For instance, as the Kafue River passes through the mining areas, an increased concentration of metals have been detected. These include sulphur, cobalt, copper, manganese, nickel, molybdenum, strontium, calcium, magnesium, potassium, sodium,

aluminium, and barium (British Geological Survey, 2001). Mining activities affect water quality supply as there have been a few cases where concentrations of metals such as manganese were past treatable limits for human consumption (NWASCO, 2010).

The main threat to the water sources currently being experienced is pollution by mining activities ("Kalulushi's Mwambashi stream pollution under investigations", 2013). The effluent from mines contains high sulphates and other pollutants which affect water extraction for domestic use. Water treatment plants have been shut down until pollution levels come within allowable levels. A typical example is when the Nkana Water and Sewerage Company suspended the pumping of raw water from two water treatment plants in Kalulushi and Garneton, Kitwe District. The water treatment plants serviced residents from Kalulushi and Kitwe, particularly Chimwemwe and Garneton customers. The water treatment plants had to be shut down until sulphate levels had come within the allowable maximum levels of the Zambia Bureau of Standards.

The background study for this thesis carried out by Liddle (2014) in Ndola in 2013 confirmed contamination of water resources. The water quality results revealed that the Kabushi River, streams, and shallow wells used as domestic water sources by individuals in Kabushi Township and informal communities had aluminium, manganese, iron, and faecal coliforms levels which exceeded the maximum acceptable values set by the World Health Organisation (WHO). Polluted domestic water sources pose a health risk to both urban and rural communities in Zambia (Lenntech, 2016; Titilawo et al., 2015; WHO, 2011a).

2.6 Communities and water resource management

Residents in most communities in Zambia are concerned about access to adequate safe water, and there have been complaints about intermittent supply, poor water quality, unequal access to water, and water shortage throughout the country. Some residents in remote and affected areas have resorted to extraction of groundwater using boreholes. Boreholes are expensive for average citizens to set up, particularly for low-income citizens and people living in poverty. Therefore, rural and informal urban residents are forced to use nearby waterways and hand-dug shallow wells (Grönwall, Mulenga & McGranahan, 2010).

To address these concerns several policy documents provide principles to deal with water resource management and several recommendations have been suggested by local and foreign researchers about the water issues being faced in Zambia (World Bank, 2009; Republic of Zambia & Federal Republic of Germany, 2007; Liddle, 2014). Unfortunately, the

information from researchers has not helped to improve the condition of affected communities. According to Maheshwari et al. (2014), this occurs because most researchers fail to recognise complex issues as it is common practice to use approaches which often deprive local communities' effective participation.

As discussed earlier in Chapter 1, from my experience during fieldwork I suggest that communities with water issues in Ndola are excluded and often not engaged effectively in water research projects. This is a concern because lack of effective engagement creates mistrust between researchers and communities, who then may become reluctant to participate in research (Research Ethics Guidebook, 2011). As a result, mitigation options and or policies based on research findings face the risk of not being implemented because when the decision-makers make policies and strategies to address issues being faced, it is considered as imposing and creates some degree of mistrust, with little involvement and support from communities (Young, 2011).

The Marxist view of water resource management in Zambia is that there is inequality because the mining companies have been benefiting from the use of water resources in copper production activities (Elster, 1986; Chilisa, 2011; Sultana, 2011). The commercial utilities benefit from the money that the communities pay to have access to portable water. The mining companies and commercial utilities have been exploiting the water resource at the expense of the communities. This occurs because the group that is in a position of power owns the resource; for example, before independence the British had power and authority over natural resources including water resources (Sultana, 2011). Since independence, the colonial approach continues to exist because privately owned mines not only exploit the nation by making huge profits that leave Zambia but also discharge high levels of sulphate and other pollutants which pollute water sources. Therefore, to safeguard peoples' health, the Nkana Water and Sewerage Company (NWSC) is forced to suspend water treatment plant operations until the sulphate levels are brought to within the levels allowed by Zambia Bureau of Standards. When NWSC operations are suspended, water supply is disrupted and communities end up not having access to water.

Therefore, the manner in which water resources are managed by the commercial utilities run by the local authorities often reflects colonial approaches, where the testing, treating, and provision of safe water promotes inequality in access to adequate safe water in Zambia. For example, in 2013 residents from Kalulushi complained about poor water quality adversely

affecting their health. Investigations were carried out and it was revealed that the water had high sulphate levels. The water treatment plants in Kalulushi and Garneton where closed until the sulphate levels were remedied. The government then directed the Konkola Copper Mine (gave it a seven-day ultimatum) to reduce sulphur dioxide levels which were polluting Mwambashi River, the domestic water source (DKL Engineering, 2013). This clearly shows that the commercial utility is required by the Zambia Bureau of Standards to treat water up to standards that ensure protecting the health of residents. However, at times action is taken after residents complain about the quality of the water. Access to water in these communities became erratic due to suspension of operations of the treatment plants. The issue was not due to water scarcity but to poor actions on the part of the commercial utility and pollution from the Konkola Copper Mine ("Kalulushi's Mwambashi stream pollution under investigations", 2013).

The government, through commercial utilities, has been benefiting from extracting raw water and providing potable water to the communities. However, many individuals from communities experiencing water issues see commercial utilities as agents of exploitation and perpetuators of inequality in access to adequate safe water. For example, I witnessed a resident verbally abusing the receptionist at the Kafubu Water and Sewerage Company (KWSC) because their domestic water supply was disrupted. The family was not pleased about this predicament because they had just moved into the house, their water supply was disrupted, and they were told that they were required to pay the amount reflected in the bill to get their house reconnected to the water supply. They informed the KWSC that the water bill was from the previous tenants and had nothing to do with it. This made this family very upset because when they called the KWSC on a Friday afternoon to resolve the issue, they were informed that they will only get access to water on Monday, meaning that they must spend the weekend without water in the house.

This made the family so furious that when they visited the KWSC offices they were threatening to beat up the people in charge of their matter because they felt that if water can be disconnected on Friday then it can also be reconnected as soon as possible since they needed water in the house instead of waiting until Monday. The KWSC has a legal right to disrupt water supply to households or properties that fail to pay their bills – "They do this task swiftly, but often when it comes to making reconnections after an issue has been solved or a bill is paid they take their time", said one of the family members – hence the attitude of the family towards the KWSC employees. I do not condone verbal or physical abuse no

matter the situation and neither am I depicting the KWSC as the bad guys, but this story is an example of the poor relationships that often exist between commercial water utilities and communities. The anger and mistrust is driven by the exploitation, domination, and marginalisation of communities by commercial water utilities.

Similarly, could researchers also be benefiting from conducting research projects with the communities experiencing water issues by producing knowledge about water resources and gaining recognition without sharing the knowledge they gain with the communities?

2.7 Conclusion

Minerals and water resources partly define Zambia's administrative history, with the mining sector as the backbone of the country. Despite Zambia having abundant water resources of generally good quality, drinking contaminated water is the main human health threat to many citizens (Water Aid, 2016). The Zambian government has been facing challenges including provision of an adequate supply of safe water and sanitation, equal allocation of water resources, and lack of integrated development in the water supply and sanitation sector (Nkhuwa et al., 2013). Many research projects have been conducted about water resources in Zambia and the findings (concerns, mitigation, or intervention options) have been built into policies for implementation to respond to these challenges. However, research and policy is not achieving the desired result because residents from communities throughout the country have been complaining about intermittent supply, poor water quality, unequal access to water, and water shortages. These water issues occur despite there being 7 private schemes and 11 commercial utilities to provide portable water to citizens (NWASCO, 2011).

To effectively engage communities in addressing these water issues, the Water Resource Management Authority (WARMA) has the national mandate to define water resource management regulations and disseminates them to the public. In addition, the vision of the Water Supply and Sanitation Act of 1997 is to promote the sustainable development of water resources and sanitation with a guaranteed equitable provision of an adequate quantity and good quality water at acceptable costs for all users (Phiri, 2000). Hence, WARMA's national mandate and the water and sanitation vision will aid in improving water resource management and contribute to the attainment of the Sustainable Development Goals.

However, ensuring that water resources benefit the people, particularly those that are the most vulnerable or affected (people living in poverty), will be very challenging if the local communities are often deprived of effective participation in water resource issues, especially if they lack access to knowledge produced from research about water resources. As a result, they may be unaware of the underlying issues concerning the extraction, use, contamination, and development of water resources, and the probable adverse impacts to their health of using contaminated water. Hence, this study centres on communities' experiences with participating in water research projects, particularly experiences of inequality in research.

In my experience, during fieldwork researchers seem to be benefiting from the knowledge produced from the studies they conduct at the expense of the research participants from communities experiencing water issues in Ndola. After completion of research projects researchers often do not share the knowledge produced with the communities that helped create the knowledge about water resource issues. This is a major concern in Ndola and other Zambian communities. Could this be a concern that applies to Zambian communities only or is it a concern that also applies in other communities around the world? The following chapter, Chapter 3, will attempt to answer this question by reviewing international literature about inequality in society and the different methodologies used by researchers to conduct research. This will be beneficial in identifying and understanding that researchers are often drivers of inequality when conducting research projects.

3. Approaches to thinking about inequality

3.1 Introduction

In the previous chapter, Chapter 2, I have shown that Zambia has abundant water resources, yet about five million people there lack access to safe water for domestic needs (Water Aid, 2016). Most of the people that do not have access to safe water are from informal and rural communities where there is an absence of water distribution infrastructure. The sources of water for these communities are wells, hand pumps, kiosks, and streams or rivers. The residents in urban areas have private schemes and commercial water utilities that provide water after treatment via distribution infrastructure to their homes. Nonetheless, urban residents often experience irregular supply and water shortages (World Bank, 2014). Due to inequality and challenges in accessing adequate safe water for many residents, several research projects using diverse methods about water resources in Zambia have been conducted. In this chapter, I will argue that inequality in scientific research is often practised by researchers who use methods that oppress people.

It is true that the methods used in social science research projects have been improved over the years to ensure the safety of the researcher and participants who both benefit from the projects (H. Scheyvens, R. Scheyvens & Murray, 2014). But there is still more to be done in improving research practice, particularly regarding the effective participation of participants, adhering to cultural protocols, and providing access to knowledge produced in research projects (Tuhiwai Smith, 2012). To understand and discuss inequality issues in society, one theoretical perspective that can be used is conflict theory because it introduces and describes an overarching theory concerning social inequality, and it explains why communities are being exploited by researchers and how change can be achieved (Swanson & Chermack, 2013).

Conflict theory (Marxism) is appropriate for this study because the inequality that researchers often practise in developing countries and with Indigenous communities (Chilisa, 2011; Tuhiwai Smith, 2012) will be explained highlighting issues regarding participants' access to knowledge created in research. This area has been surprisingly neglected by many researchers until recently, as most literature is focused on improved research methods which take into account individuals' effective participation and ethical considerations in research projects (Fernandez, Kodish & Weijer, 2003; Leach & Scoones, 2005). However, sharing

with or having access to knowledge produced in research by participants is one of the ethical considerations that is often neglected by researchers.

Because of the power differential between researchers and communities, particularly in low income communities in Zambia, there is a very real possibility of researchers participating in colonial forms of oppression. Failing to treat community members as co-producers of research knowledge, or failing to provide access to research results that impact the community could both be understood as oppressive practices. Drawing on Marx, Freire (1970) defines oppression as an unjust reality were people are kept down by economic, political, social, and educational forces. Young (2009) further identifies five types of oppressive practices: exploitation, powerlessness, marginalisation, cultural imperialism, and violence. Exploitation occurs when people's efforts are used to produce profit without them benefiting fairly. Powerlessness involves some people who are considered to have power while others have not, and those that have no power tend to have no voice or free will over matters that concern them. The act of keeping a group of people in a lower social status or the process of excluding them from society and/or issues that concern them is marginalisation. Cultural imperialism occurs when the culture of the more powerful group dominates or controls people in society. As a result, the beliefs of such a society are based on the experience, values, goals, and achievements of the more powerful group. Violence involves the act of attacking and/or treating people or their property with the intent to hurt or humiliate them.

In this chapter I will attempt to show that researchers practise oppression by using methods that reflect dominance, exploitation, and marginalisation in regards to knowledge produced from participants. This chapter begins with several examples of how researchers have oppressed people from several communities internationally. A detailed discussion about concepts and methods for conducting research projects drawn from conflict theory by several scholars is included. It is from these concepts and methods that I will further explore participants' access to research findings to help me develop an appropriate approach or method for returning water quality results to communities that participated in Liddle's study in 2013, in Ndola, Zambia.

3.2 Oppression in scientific research

Social scientists are required by ethics committees to take back transcripts and summary reports to participants, but natural scientists do not have to go through ethics committees if they are considering conducting research about, for example, water, volcanoes, reefs, soil, or vegetation. Hence, they are not required to take back reports or a summary of results to communities where they collected samples (such as water, soil, or plant samples).

In both the natural and social sciences, research projects in developing countries are often conducted using methods that are structured in ways that benefit the researchers at the expense of the participants. This is because information is often exploited from participants by researchers who have more economic, political, and social power. The information gathered by researchers is used to produce knowledge regarding a subject matter which is then owned by the researcher, making them even more privileged as they attain another title or more recognition in the research world.

A story is told about an anthropologist who visited the Indian reservation during winter with the aim of making "observations" (Louis, cited in Chilisa, 2011). A book was written based on these observations. Future anthropologists used this book to study and conduct observations in the reservation years later to validate what they studied from the observations in the book. At no point was ownership of this data negotiated with the community, nor were they given a chance to correct it. This is an example of how knowledge is constructed and accumulates into a body of literature that guides future research projects in communities in problematic ways.

Another contemporary example is the story of how western-trained researchers stole African indigenous knowledge of local resources (Chilisa, 2011). The San, via observations and experiments, discovered the hoodia cactus plant which grows in the Kalahari Desert. The plant has medical properties that stave off hunger, so generation after generation of San have been chewing the plant during long hunting journeys (Chilisa, 2011). The South African Council for Scientific and Industrial Research, along with Phytopharm (a UK-based company), isolated the active ingredients in the plant that stave off hunger, renamed it P57, and used it to manufacture diet pills which they sold for a lot of money (Commey, cited in Chilisa, 2011). The San had to fight to reclaim intellectual property of the plant's qualities (Chilisa & Preece, 2005). A similar incident occurred with the Hagahai tribe in Papua New Guinea where the U.S. government filed patents on Hagahai cells taken from members of the tribe members without telling them about the study (Tuhiwai Smith, 2012). Hagahai cells

have unique genetic characteristics (HTLV-1) that resist a particular type of leukaemia, so the United States National Institutes of Health patented this gene line which was made available for purchase.

Oppression in research does not only occur in developing countries or former colonies; even in developed countries it is common for researcher to conduct research that oppresses participant communities. For example, a story is told about a recent research incident that was harmful to the participant community. The Havasupai American Indian tribe filed a lawsuit against researchers from Arizona State University for using blood samples taken from some members of their tribe for other studies (like on schizophrenia, inbreeding, and migration of ancestors) in addition to the study on the genetics of diabetes as they had been informed. When the data from this study was published, it was humiliating and harmful to the Havasupai tribe (Sahota, 2007).

Another recent incident occurred in Spain, where the Roma people have been the most studied in history (García, Melgar, & Sordé, 2013). For many years, researchers have gone to Romani communities only to gather information, which they publish, and then do not go back. Romani communities became tired of being the object of these studies that only benefit researchers without any benefits returning to them (Munté, Serradell, & Sordé, 2011). The researchers always say the same things about them, excluding their voices and experiences – and therefore research is carried out on Roma, without Roma (García et al., 2013). This type of research is exclusionary as the Romani families have been used and viewed as objects to get interesting data from. Exclusionary research always justifies existing inequality and social exclusion practices whereby the Roma are blamed for the conditions they are in (García et al., 2013). Consequently, there is a strong legitimate unwillingness among the Roma people towards anything that is associated with research. Currently the Roma people no longer accept studies conducted using exclusionary research approaches.

From these examples, it is evident that researchers often exploit information and data from communities to produce knowledge which they benefit from at the expense of the individuals who helped produce it. It is common for participant communities to not benefit from research; instead they are often hurt, upset, and left in the same condition they were in before the research project was conducted. This is unfortunate because research is often conducted with the aim of advancing knowledge and helping people concerning an issue, the idea being to enable them to survive by engaging in productive activities informed by the knowledge

produced in research. However, there are a number of approaches for how to overcome oppression of participant communities in research, including critical pedagogy, participatory action research, and decolonising methodologies. To be able to better understand these approaches a brief account of the overarching theory – Karl Marx's conflict theory – is discussed first, followed by the approaches mentioned.

3.3 Conflict theory

To appreciate the effects of participants' exploitation by researchers, I examined in detail how inequality among groups occurs, its outcomes, and how change can be attained. Conflict theory, a Marxist paradigm in sociology, is grounded in the view that society is an arena for inequality, which leads to conflict and change. Inequality occurs because society is structured in a manner that benefits a person or group at the expense of other people coupled with competing relations between dominant and minority groups (Elster, 1986).

Conflict theory was based on the idea that in order to exist, people engage in productive activities, and as a result two types of relationships regarding the means of production exist (Cox, 1998). The two types relationships formed concerning the means of production are people who own the means of production (the bourgeoisie) and people that work for the means of production or productive property (the proletariat).

The relationships that people have with the means of production create social classes or groups, where the laws and norms are in favour of the interests of those in positions of power (Elster, 1986). Consequently, the distribution of resources inevitably leads to inequality and creates conflict between groups; conflict occurs because the bourgeoisie reap huge profits at the expense of the proletariat, who offer labour for wages. The group that controls the means of production controls the production of knowledge and ideas (Chilisa, 2011). Similarly, the group with control over the resources also controls access to these (Sultana, 2011). Therefore, when conflict and competition between groups occurs, social order is maintained via domination as the group with the most economic, political, and social power wins by controlling access to a resource and knowledge about the means of production.

Conflict theory is appropriate in this study as it explains dominant western-based research paradigms which marginalise knowledge produced in other cultures. The dominating and competing structure often used in the system of research where the researchers often benefit by exploiting the participants inevitably leads to inequality and further creates conflict between researchers and individuals. This conflict influences behaviour because it inevitably

leads to the individuals or participants feeling alienated: consequently, they develop a consciousness, which is the realisation that they are being oppressed (Elster, 1986). Critical consciousness enables the oppressed group to have a deep understanding of the causes of their reality and that their reality is real and historic (Freire, 1970). This allows for the transformation of oppressed individuals, which can be achieved through praxis – "theory plus action". Praxis leads to the realisation that they can confront their reality and can change or create their desired reality by taking action (also known as revolution) based on their values or needs, allowing communities to have complete control over their thoughts and what they want to achieve (Freire, 1970).

For example, society can be reorganised to get rid of researchers' domination by setting up methods that allow for collective production and ownership of knowledge produced in projects. A research method with an unequal structure can be overthrown by individuals' refusal to participate in projects. Therefore, critical consciousness is significant to individuals because without it, oppression on the part of researchers will be seen or thought of as a normal reality which is not questioned, and thus individuals remain submerged in the unjust reality. The researchers will maintain their status quo, which is the position of advantage, allowing them to progress or develop further at the expense of research participants, who will continue struggling to be heard and to obtain the knowledge produced in a fair manner. Furthermore, conflict will or can continue if oppression in research is not overthrown. To free people from oppression there is a need to raise awareness (share knowledge) in order for them to be able to act for their own liberation after critically reflecting about their situation, as shall be discussed in the next section.

3.4 Critical pedagogy

The fundamental principles of Marxism are at the heart of critical pedagogy, which was founded by Paulo Freire, a pioneer in human development in the early 1970s during the period of decolonisation of former colonies. Critical pedagogy was developed to liberate people from oppression in Brazil because after the colonisers left, the institutions and system remained whereby the colonial culture, way of thinking, language, and accent were considered more developed (Freire, 1970). This then became a form of internalised colonisation as people become colonial subjects by thinking less of themselves. As a result, people believed that they are not capable of contributing to their society, making things better, or achieving desired change.

In post-colonial developing countries, the system and methods used in research projects are often based on the colonial culture, approach, and language as these are considered more developed than those of people in former colonies (Chilisa, 2011). Conducting research using the colonisers' system is a form of oppression as people become subjects and are investigated using colonial views, methods, and language (Chilisa, 2011). Therefore, to discourage internalised colonisation people need to be informed that they are worthy and that they have the power to change their situation. For example, in Papua New Guinea, appropriate research methods led communities to understand that they are active agents in achieving desired change and in shaping their future (Passingan, 2013).

Oppression in research can be overthrown when people go through a process (Freire, 1970). First is the realisation that oppression in research exists. Second is to understand that change can be achieved. To get the desired change and prevent dehumanising people, Freire (1974) suggests taking full account of their views, actions, and what they want to achieve. However, researchers often relate to knowledge produced in research as a commodity or something to own and gain from instead of something that must be used to achieve the desired change or tested, questioned, and produced (Freire, 1970). According to Allman & Wallis (1997), this is because the knowledge is considered and used the same way as other commodities by setting it apart from broader societal relationships. In addition, Freire (1970) argues that true knowledge emerges as a result of critical inquiry with people about their community. Therefore, researchers can conduct critical inquiry with individuals about issues being faced in their communities to co-produce true knowledge which can be used to address the issues. In this way, communities can be encouraged to develop praxis rather than to receive, fill, and keep information being deposited by researchers, which Freire (1970) termed as the banking concept of education.

Freire's main concern was oppression in education, particularly the banking concept of education, where knowledge is considered as a gift given by individuals considering themselves knowledgeable to individuals they consider to have no understanding. Banking education is a top-down model whereby the educator is seen as all-knowing and most important (Freire, 1974). Hence, knowledge is deposited into students by educators. Equally, I argue that researchers often consider themselves as more knowledgeable about issues than the local communities experiencing the issues. Consequently, they often conduct research and deposit knowledge produced in research using the top-down model. This view is shared by Milimo, Shilito and Brock (2002), who argue that public participation and taking into account

local people's views is not done because top-down approaches are often used. They recommend using methods that are community-based instead of top-down approaches in which decisions are made by those in advantaged positions who then tell local communities what they should do.

The depositing or transferring of information is not education; cognition is education (Freire, 1974). Cognition is the process of obtaining knowledge or understanding through thought, experience, or senses. For example, when a researcher behaves in a way that makes them appear more knowledgeable about poor water quality, it is seen as the researcher being there to give to the people who do not have anything to offer the researcher. This is not the case because the people have more information about poor water quality as they are the ones experiencing the water pollution issue. The depositing method incapacitates people and makes them passive as it does not allow interaction or engagement in open dialogue for the researcher and individuals to address the water pollution issue together.

As a result, the capacity of people to think critically and become transformers of their community is suppressed. The depositing method is not democratic as democracy is about having a right to be heard, to express interest or conforming to ideas and beliefs. Several scholars oppose the depositing of knowledge as it incapacitates people from being critical thinkers and taking action regarding an issue (Beaulieu, 2013; Kapoor, 2002; Park, 1999; Karlsen, 1991). Hence, they recommend dialogue between the researcher and individuals who become co-researchers. Similarly, Chambers (2007) suggests allowing people to ask questions rather than forcing an idea on them.

For example, a pilot project about sanitation was conducted in Kebengele village, a rural area in Southern Province, Zambia. Group activities were conducted where the residents were taken through a "guided discovery" involving humour (Harvey & Mukosha, 2008). This helped illustrate to the residents the extent of the problem and helped them better understand that open defecation is unnecessary, unpleasant, and unhygienic. The residents of the village gained a better understanding that open defecation results in their eating their own and their neighbours' faeces. The desire for change by the residents was as a result of having access to sanitation information, and consequently a better understanding about the realities of open defecation.

Over two months there was a significant improvement because the number of residents using a toilet increased from 23% to 88%, without outside funding for building latrines. The residents designed and built latrines using their own innovative ideas. According to Harvey and Mukosha (2008), the pilot project was a success, especially seeing that it occurred in the wet season,[1] and it encouraged people to act collectively to improve sanitation while fostering a strong sense of individual and community pride. This clearly shows that access to knowledge produced from research is necessary for the benefit of participant communities.

Critical pedagogy is an approach that was used to liberate Latin American communities from internalised colonisation during the decolonisation of former colonies in South America. It is a practical theory that can be used to understand appropriate approaches which can be employed in research projects in post-colonial developing countries like Zambia. Overall, Freire's framework is a people-centred approach and could sometimes be people-led. This is because the focus is on providing knowledge (raising awareness) and the critical consciousness of people so that they may act for their own decolonisation. However, critical pedagogy cannot be used as a blueprint in water research projects in Zambia because the specifics are different. Zambia is a post-colonial developing country in the southern region of Africa with communities that have a different culture from Latin American communities. If critical pedagogy is to be used in a research project, the design and approaches should be based on the culture (local context) of the oppressed participant community in order to ensure their effective participation and liberate them (see section 3.6). In addition, to achieve effective participation via people-centered approaches, participatory action research is recommended by Robert Chambers.

3.5 Participatory action research

Since the 1980s, Robert Chambers, an academic and development expert, has been calling for a complete change regarding the way we think about and carry out research projects by adopting the use of participatory approaches. Chambers started with participatory rural appraisal (PRA), which he describes as one of the approaches that enable sharing, enhancing, and analysing local people's knowledge of life and conditions in order to plan and act (Chambers, 1994a). PRA has origins in other activist participatory research approaches, including rapid rural appraisal (RRA) where outsiders elicit and extract information, but in

[1] During the wet season, there is an increased probability of contamination of water sources via runoff and an increased number of flies due to ambient conditions (hot and wet) where they thrive and may contaminate food with faecal matter.

PRA local people have access to information as it is more shared and owned by them. Furthermore, in PRA the parameters of the problem are explored, data collecting and analysis methods are devised or developed, and intervention or mitigation strategies are planned or given (Beaulieu, 2013).

Therefore, PRA is people-centred but it has limits as it is not people-led, even if it may start from local people's concerns and efforts. In addition, while assistance from outsiders such as researchers is required, much of the work is done by local community members (Chambers, 1994a). This approach has been applied in health and food security, poverty and social programs, agriculture, and natural resources management. The participatory methods used include engaging local people in grouping and ranking of wealth and well-being, trend and change analysis, matrix scoring, seasonal calendars, transect walks, analytical diagramming, and social mapping and modelling.

Due to dominant behaviour by outsiders the analytical capabilities of local people were not fully recognised. For participatory approaches to improve and be more beneficial to the local people, their knowledge and opinions have been incorporated into the planning and management of projects. Hence, Chambers (2007) suggests getting rid of unjust approaches by partnering with people instead of behaving as superior or a rescuer. Chambers (2014) further recommends approaches that are more community-driven and process-oriented instead of top-down approaches used in research projects designed and carried out by outsiders.

This can be achieved via local communities' thorough involvement in research projects through effective participation (Chambers, 1994b). Participation is a vital component of a people-focused development model whose aim is to put the most affected or poorest first. Therefore, Chambers has designed several tools that can be used to enable local communities' thorough involvement in research.

For example, Chambers (1994b) and Goldman and Abbot (2004) encourage the use of participatory action research (PAR) as a tool in research projects. PAR is a research process whereby the practitioner is involved in every step of the project, including actions arising due to the research (Karlsen, 1991). The main difference from other types of action-oriented research is that the local people play a central role in describing the issues being faced by the community while encouraging others to be on board as well as sustaining the research work (Park, 1999). For example, local people who are affected by a problem initiate the work

instead of trained individuals like scholars (Beaulieu, 2013). This is achievable when the power structures that often occur in research are overthrown to enable the local people to become action researchers who also decide to work collaboratively with other members of the community to address issues. The knowledge produced using these practical methods have been successfully used by local communities to improve sanitation by doing away with open defecation in Zambia (Harvey & Mukosha, 2008), in addressing food security issues in poverty-stricken regions, and in the managing of groundwater resources in Asia.

For example, in the states of Gujarat and Rajasthan, India, the situation resulting from unsustainable use of groundwater was becoming critical (Maheshwari et al., 2014). To address this situation effective participation from all stakeholders, including local communities, scientists, and government, was carried out. The focus of this project was the "village scale", with local communities engaged in groundwater monitoring and education to explore options for groundwater sustainability. This allowed for social, scientific, economic, policy, and political involvement to occur. As a result, it was recognised that the issue in farming communities was emotional and complex because their livelihood and survival depends on access to groundwater (Maheshwari et al., 2014). The participatory approach led to an understanding of the issues and challenges, as well as options for improving groundwater use in a sustainable manner. The approach was a success as local communities and other stakeholders worked together to achieve a common goal by creating new information and a theory for improving a complex situation, where relevant issues that may otherwise be neglected by researchers were identified and highlighted (Fischer, 2000; Collins & Evans, 2002).

According to Meyer (2013), scholars have successfully used PAR to conduct research which reflects the aim of creating positive social change. This is because research is seen as a guide to action not only for researchers but also for people who are empowered to change their communities. For example, PAR was used in Mayange, Rwanda, where over 25% of the population does not have access to clean water (Mitchell et al., 2015). This is because most of their water sources are contaminated and can cause health problems. In this project, geographic information systems technology and global positioning system equipment was used to explore the spatial dimensions of public health. Local village leaders, guides, and staff from the National University of Rwanda were involved in building a database of water sources.

Water access points such as lakes, cisterns, and wells were mapped and classified to aid in evaluating the distance from households to safe water sources. Maps are useful because they provide precise locations where individuals can get their water, which is beneficial for local sustainable development programs. For example, the map can be useful in identifying areas with contaminated water sources and to support water quality improvement decisions, such as choosing a suitable location to dig a new water source and ways to protect an open-pit water source from contamination. The map created from the research project is being used as a tool for the planning and evaluation of indicators by project coordinators; the areas that most need an improvement in the quality and quantity of water sources have been identified.

Apart from their tools, the behaviour and attitude of the facilitator or researchers is the backbone to action research. Hence, Chambers (1994b) recommends that facilitators or researchers be creative and flexible in their approaches as participatory research not only demands institutional change but also a change in their conduct. In addition, research projects can be carried out successfully and the desired change can be achieved when the local people are considered and put at the centre of all stages of the research process (Chambers, 1997). Chambers drew this understanding from the Freirean concept (see section 3.5), which encourages empowering poor people through their own analysis and action. This can be achieved by sharing the knowledge produced in research projects with the local people as they too are owners of the knowledge rather than just the researcher. Therefore, several scholars like Chambers (1997), Ostrom (1996), and Shortland and Gregory (1991) focus more on the local people and the outcome of projects because the knowledge produced is given, designed, and driven by the local people themselves, making it locally appropriate, effective, and beneficial.

Chambers' PAR approach is a tool that has been successful in engaging local communities in research projects in developing countries including Zambia (Chambers, 1994b). PAR demands a change not only in the research system or approach but also in researchers' conduct. Chambers (1994b) recommends being creative and flexible, as a researcher's conduct is the backbone of action research. PAR has been beneficial because it is community-driven, process-oriented, and focused on the people or communities affected the most by an issue. Chilisa (2011) agrees with Chambers about the conduct of researchers in action research, arguing that researchers' commitment is significant. Commitment is achieved by defining responsibilities and consistent engagement in self-reflection in order to promote and privilege the rights of the disempowered community. However, it cannot be used as a

blueprint to conduct water research projects with Zambian communities because it fails to address fully issues regarding history, social context (culture), and ownership of the knowledge produced. These issues are fully addressed via indigenous methodologies, a decolonising approach that is appropriate for conducting research with Indigenous communities.

3.6 Decolonising research

Tuhiwai Smith and other decolonising scholars propose going further than PAR to have indigenous-led research based on questions or issues set by Indigenous peoples, where Indigenous researchers are responsible to their people and communities in traditional ways as well as under research ethics requirements. An Indigenous researcher is a scientist or scholar that engages in contemporary research to bring benefits to their communities and people, and a non-Indigenous researcher engages in a study with the purpose of benefiting an Indigenous community that they do not belong to (Weber-Pillwax, 2004). Hence, decolonising research is an agenda that has been set by Indigenous communities and is carried out by Indigenous researchers who have overthrown research approaches that oppress Indigenous people. They are calling for research methods that use equal structures and are based on the highest ethical standards.

The decolonising agenda has been set due to the experience of Indigenous peoples in research (Chilisa, 2011; Tuhiwai Smith, 2012). Researchers have a perception that their projects are beneficial to the community experiencing an issue. This is because the aims of researchers are often to help people experiencing an issue in a community, contribute to the knowledge that exists concerning an issue, and produce new knowledge that can be used to understand and address an issue. However, many communities around the world have a different perception. For example, Indigenous peoples do not necessarily perceive such projects as beneficial.

The approaches that have been used in Indigenous communities to conduct research projects fail to consider their history, social context, and customs and to address issues concerning control of project activities and ownership of the knowledge produced. It is due to these failures that Freire's theory and Chambers' approaches have failed to deliver the liberation of oppressed groups (Ellsworth, 1989). This is because the approaches are considered as a universal method that must be followed precisely for research projects to be effective (Tuhiwai Smith, 2012). Therefore, if Marxist theory, critical pedagogy, and PAR are to be used, the aim and design of research projects should be based on local context so as to

emancipate the oppressed groups. The emancipation of such groups is evident when they take control of projects and of their own lives under their own terms to achieve a desired reality.

The desired change as a result of research projects in Indigenous communities has often not been achieved. This is evident because Indigenous peoples can sometimes hate and distrust research due to experiences where information is exploited to benefit the researcher and is misinterpreted or presented in a demeaning manner (Tuhiwai Smith, 2012). Therefore, in indigenous vocabulary, "the word research is probably one of the dirtiest words" (p. 1) as it brings about bad recollections and silence and elicits a discerning and mistrustful smile from many Indigenous individuals (Tuhiwai Smith, 2012). This is because the research methodologies used in Indigenous communities are based on Euro-western ideas where the perspective of Indigenous individuals is often not considered and the benefits of research projects are often not seen (Marshall & Batten, 2004). In addition, research based in Euro-western ideas employs top-down approaches which fail to engage local communities in genuine dialogue (Chilisa, 2011).

This is inappropriate because indigenous perspectives are significant as they aid in explaining or answering "how" and "why" questions regarding an issue. Hence, Tuhiwai Smith (2012), an academic and Māori development expert, states that conducting research with Indigenous communities requires a research project that is beneficial, is designed based on the culture, and takes in the perspectives of the Indigenous people involved. For example, kaupapa Māori research is a decolonising methodology used in New Zealand; it involves approaches where the methodologies and protocols used are culturally appropriate and are directed by the Māori communities involved to achieve a positive change or benefit from the research project. The methods used are respectful, enabling, healing, and educative in order to encourage people towards self-determination.

Tuhiwai Smith (2012) further argues that cultural protocols, values, and behaviours are fundamental parts of indigenous methodologies that automatically need to be included in the design of the research and discussion of results. Tuhiwai Smith (2012) recommends that at the end of a research project, results are disseminated back to the people, and this too can be conducted in a way that is appropriate culturally while using a language that people can understand as it is respectful and ethical while not preventing thesis or article writing. Disseminating knowledge after completion of research and ensuring that the knowledge reaches the research participants can be done in various ways. Tuhiwai Smith (2012)

highlights sharing knowledge (reciprocity) and reporting back (feedback) to the people as an important process, and one that is poorly addressed in scientific research. This may be because researchers find it easier to distribute reports, pamphlets, and articles to organisations than to engage in knowledge-sharing processes with communities that helped in producing the knowledge.

Tuhiwai Smith (2012) states that sharing knowledge is expected of researchers, particularly Indigenous researchers, as they are residents in their communities. As insiders, they too will live with the outcome of their research, as will their family and community. The term "sharing knowledge", as opposed to "sharing information", is used deliberately (Tuhiwai Smith, 2012). This is because it is the responsibility of researchers to share theories and analyses which inform the ways knowledge and information are constructed and represented instead of simply sharing surface information. Individuals are interested in knowledge produced in research, and therefore, as Tuhiwai Smith (2012) argues, it is arrogant to think that they are not interested in and will not understand the deeper issues.

Sharing of knowledge produced in research is a responsibility of researchers (Tuhiwai Smith, 2012). However, other experts or researchers refer to "dissemination of results" instead of "sharing of knowledge". This is normally very uninteresting to non-researchers because it is too technical and distant (Miller, 1986). For Indigenous researchers, sharing involves clarifying knowledge with the community using simple words and examples. This can be achieved through having community gatherings where oral presentations that conform to cultural protocols and expectations can be carried out. During the community gatherings, the audience at times may need to be involved emotionally (by expressing their sadness or anger and happiness through smiles or laughter), reflect deeply, and discuss their challenges (Tuhiwai Smith, 2012). Therefore, community gatherings require a speaker who is not only capable of openly sharing knowledge but also whose conduct sits within the customs of the community.

Tuhiwai Smith (2012) argues against conducting research if the customs and views of Indigenous communities are not included and their lives are considered insignificant. Indigenous activists and communities strongly agree with this; hence, they ask researchers wanting to conduct research in their communities questions such as: Who owns the research project? Who will benefit from it? Who designed the questions and framed the project's scope? Who will conduct the research and write up the knowledge produced? How will the

knowledge be shared? Who will own the knowledge produced from the research project? (Tuhiwai Smith, 2011). Many researchers can answer these questions with integrity, while many others cannot as they see this as a test or proof of political correctness and approach such questions with some cynicism. Many researchers have also often regarded the values, beliefs, practices, and customs of Indigenous communities as barriers or unfamiliar conduct in research methodologies which researchers are required to be aware of in order to conduct their research project without causing offence.

Chilisa (2011) argues that following cultural protocol when conducting research projects is not a hindrance, especially if research is deployed as a tool for social change in Indigenous communities. Conducting research rooted in indigenous knowledge, including following cultural protocol, is considered successful because research is a process where local information, data, or samples are collected and used to co-produce knowledge that is beneficial to both the researcher and the community (Durose et al., 2011; Jung, Harrow & Pharoah, 2012). Sharing a heritage with an Indigenous community does not necessarily make the researcher an insider because they may still be seen as an outsider and their credibility will be considered. For example, Geleta (cited in Cram, Chilisa & Mertens, 2013) experienced this challenge when conducting research in Ethiopia where the Indigenous community were suspicious of Geleta whom they saw as a threat, and hence were unwilling to share information until Geleta made the research aim clear and observed proper cultural protocol.

Therefore, Geleta (cited in Cram et al., 2013) recommends respectfully engaging with the community throughout the entire research process while expecting, accepting, and allowing onself to be interviewed by the research participants. This helps to build a mutual understanding and relationship where the participants feel comfortable enough to give the information required and to share their experiences and stories. Storytelling in indigenous methods is one of the data collection methods used as it reflects traditional knowledge, culture, language, and ways of knowing (Chilisa, 2011). Conducting research using indigenous methodologies does not perpetuate self-centred western research methods, which are constructed using western ways of knowing.

Dominant research methods constructed using western colonial methods have marginalised peoples' ways of knowing, which results in the designing of research projects that are inappropriate to the needs of the community (Chilisa, 2011). This is because dominant

research methods are based on the belief that knowledge is an individual thing where the researcher is an individual searching for knowledge. In this case knowledge is considered as something that is gained and owned by an individual. However, in indigenous paradigms knowledge is relational because it is shared with others; therefore, when conducting research the researcher is answerable to their relations (Wilson, 2008). Chilisa (2011) recommends the use of indigenous decolonising research methods as they include indigenous knowledge that is appropriate and responsive to the experiences, concerns, and needs of the communities involved. The knowledge produced is then shared among the people to enable them to act in the face of the issues being experienced.

Therefore, having access to research results gives Indigenous people a basis to plan and act where the participants are considered as co-researchers who discuss the research results with emphasis on personal and social change. It is also important for the researcher to understand that the research they are conducting has the power to condemn how issues are addressed or mitigated and to describe solutions to challenges being faced in former colonised Indigenous peoples. The role of a researcher in research should be that of a provocateur and transformative adviser who is guided by responsibility, respect, reciprocity, and the rights and regulations or procedures of the Indigenous community involved.

3.7 Conclusion

Conflict theory was used to explain the oppression of people in society and how change be achieved. I have shown that oppression in research is a common concern globally and not just in Zambian communities. This is because in scientific research, scientific data or information is not usually made available to participant communities or individuals. The knowledge produced in research is considered and often used as a commodity by researchers (Freire, 1970). The researchers maintain their dominance over communities that participate in research projects by exploiting participants as they often benefit at the expense of local communities. Therefore, in such a situation, social order is maintained via domination as the researchers have more economic, political, and social power while the local communities have less or no power in research projects. This leads to conflict and competition between the researcher and local communities because the views, actions, and desires of local communities are not fully considered – typical of colonial research methods (Freire, 1974).

To assist local communities, Chambers (2007) recommends getting rid of unjust colonial methods and adopting participatory action research (PAR) methods to allow for collaboration rather than the researcher behaving as superior or a rescuer. Chambers (2007) further recommends showing people their reality; this is because PAR enables the researcher and local communities to co-produce knowledge and encourages action to address issues being faced by communities. However, PAR cannot be used to conduct research projects about water resources in Zambian communities on its own because it fails to fully address issues regarding history, control of project activities, social context and customs, and ownership of the knowledge produced in research (Chilisa, 2011; Darou, Hum & Kurtness, 1993; Tuhiwai Smith, 2012).

Since these issues are fully addressed via decolonising methodologies and particularly indigenous methodologies, these are the ones used in this study. Decolonising methodologies are adopted and influenced by various philosophies and theories with Karl Marx's conflict theory as the overarching theory. Overall, the review of the literature in this chapter has revealed that Freire's framework and indigenous methodologies are the most appropriate decolonising methodologies to be used to examine appropriate methods for returning research findings to communities facing water quality issues in Ndola, Copperbelt Province, Zambia. I now move to the methodology chapter where I will apply decolonising methodologies to Ndola.

4. Methodology for returning research findings

4.1 Introduction

Methodology is the theoretical lens, the methods and tools through which research is designed and conducted (Walter, 2006). Research methodology is different from research methods as methodology is the theory and analysis used in research, while a research method is the technique used to gather evidence (Harding, 1987). The research methodology used is important because it guides the questions to be asked, determines the instruments and methods used, and shapes the analysis (Tuhiwai Smith, 2012). Therefore, the methodology selected for use in a study must be well thought out as it has an effect on the questions asked, the methods used, and data analysis. It also has an impact on the quality and reliability of the results obtained. In this study a qualitative approach was used to explore participants' experiences and perceptions regarding water research projects (Patton, 2002; Thurmond, 2001). The experiences and perspectives of participants were investigated to gather an understanding of the social setting, the processes at work, and the reasons behind these (Mugenda & Mugenda, 2012). The social processes examined using the qualitative approach can be answered through the "what", "why", and "how" questions regarding a subject matter. To answer the question "*What method is appropriate for returning water quality results to communities facing water quality issues in Zambia?*" several methodologies can be used. This study was guided by decolonising methodologies. This chapter gives an overview of Liddle's study because the water quality results I returned to the communities were from her study. It also includes a detailed description of decolonising methodologies and the ones used in this study, which are Freire's framework and indigenous methodologies. The ethical considerations, participant selection, methods used in the field, and limitations, particularly those that may have affected the results, are also included, as is a detailed description of the method used to analyse the data.

4.2 Liddle's study

In 2013 Elizabeth Liddle carried out a study for her master's thesis in Ndola, Copperbelt Province, Zambia. The title of her research was "Assessing the state of the water quality, the challenges to provision, and the associated water development considerations in Ndola, Zambia." I assisted Liddle with her fieldwork from April to June 2013. The study involved the measuring of water parameters and collection of water samples from waterways, hand-dug wells, and boreholes for laboratory analysis. In addition, interviews with key informants

and local water-user questionnaire surveys were conducted in 17 localities in Ndola (see figure 5).

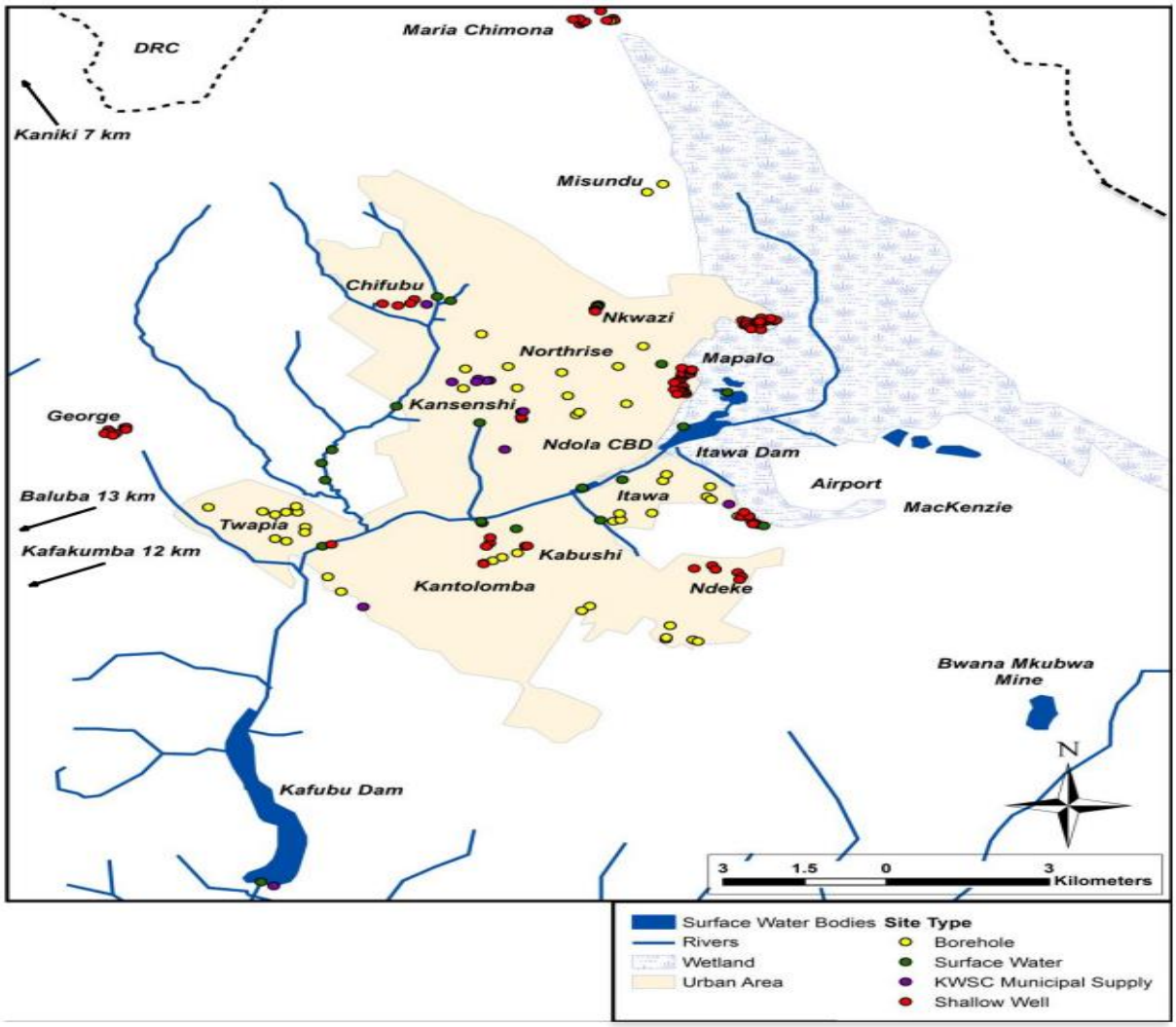

Figure 5: Location of sampling sites in Ndola city studied by Liddle in 2013 (Source: Liddle, 2014).

Temperature, pH, and electrical conductivity were measured in the field while contaminants such as total coliform concentrations and heavy metals were analysed at the laboratory**.** The key informant and water user data was coded and arranged in key trends which included differences, concerns, and challenges faced regarding water supply in Ndola. Liddle's study revealed that some waterways and hand-dug shallow wells in Ndola contained contaminants – mainly aluminium, iron, manganese, and faecal coliforms – which exceeded recommended maximum values set by the World Health Organisation (WHO, 2011a).

This was the case particularly in communities which rely on hand-dug shallow wells and waterways for domestic water sources as they lack infrastructure for water supply. Furthermore, Liddle's study revealed that there is a difference in water quality between surface water and groundwater. This is because boreholes are dug deeper into the aquifer where water is filtered as it percolates through the phreatic zone and is thus better protected from contamination.

To significantly improve access to safe water in Ndola, Liddle (2014) recommends further development and use of groundwater resources for drinking and irrigation purposes in preference to surface water. Surface water is not safe because it has been subjected to extensive contamination due to heavy mining operations over the past century, particularly in the Copperbelt Province (AHC–Mining Municipal Services Ltd., 2004). Nonetheless, there is great concern regarding fecal coliform contamination of groundwater resources from pit latrines. To address this concern Liddle recommends protecting the shallow aquifers from systemic contamination from pit latrines and protecting wells to safeguard the health of individuals by preventing them from consuming contaminated water.

It was during Liddle's study that one particular issue stood out to me, and I experienced it later during fieldwork. Several individuals from the communities refused to participate in research because they wanted access to the findings (see section 1.2). I was concerned about this issue because research is conducted with the aim of benefiting affected communities. However, as sharing findings with participants is often not done by researchers, which in my opinion is highly unethical, this has created mistrust between researchers and several individuals from communities in Ndola. I discussed this issue with Liddle, who is also concerned about not being able to help the participant communities. So, with her permission I used the data and research findings from her study in 2013 to return water quality results to Kabushi, Nkwazi, and Kaniki communities.

I conducted most of the semi-structured interviews and held focus group meetings with participants from these communities, which represent three types of communities that are experiencing water quality issues. Residents from these communities are forced to use shallow wells and nearby rivers or streams as sources of water for domestic use, and they lack infrastructure to distribute water to households. For example, Kaniki is an informal community located in a rural remote area, Nkwazi is an informal community adjacent to

Ndola's suburban area, and Kabushi is a planned township with water distribution infrastructure in most of the households, although some of its residents rely on communal taps, shallow wells, and the Kafubu River. Secondly, I know the households Liddle and I visited, and these are among the communities Liddle discussed further as case studies in her thesis.

4.2.1 Water quality results: Kabushi Township

The sources of water in Kabushi Township and the water quality results from Liddle's study are outlined in box 1.1.

Box 1.1 Kabushi Township's water quality results

Kabushi is a high-density planned township with about 12,094 residents. Water for domestic needs is from shallow wells, boreholes, the Kafubu River, communal taps, and taps in households provided by the Kafubu Water and Sewerage Company. The water quality results revealed that the Kafubu River (see Appendix H) had high levels of aluminium, iron, and fecal coliforms, while the shallow well (see Appendix H) had high fecal coliform levels over the maximum acceptable value set by the WHO (Liddle, 2014), as indicated in the table below.

Kabushi area	*Shallow well*	*Kafubu River*	*WHO (2011)*	*Concern*
Aluminium	42 µg/l	262 µg/l	90 µg/l	☹
Iron	34 µg/l	468 µg/l	300 µg/l	☹
Faecal coliforms	11 CFU/100 ml	127 CFU/100 ml	0 CFU/100 ml	☹
Key ☹	Polluted water (contaminant above maximum acceptable value)			

Probable source of contaminants and significant concerns

Aluminium and iron are abundant elements that occur naturally in the Earth's crust and contribute to the properties of soil (Lenntech, 2016). Bacteria originate from intestinal tracts of warm-blooded animals (Titilawo et al., 2015) and are released into the environment through deposition of faecal material. After rainfall, aluminium and iron particles and bacteria in the environment enter waterways and wells via runoff.

Long-time exposure or uptake of significant concentrations of water-soluble forms of aluminium can lead to serious health effects, such as damage to the central nervous system, Alzheimer's disease, severe trembling, liver dysfunction, and kidney dysfunction (Lenntech, 2016). In addition, high concentrations of aluminium can cause stunted roots in plants, leading to a decline in crop yields as the ability of roots to absorb water and nutrients is affected. Iron gives water an undesirable metallic taste and can cause conjunctivitis, choroiditis, and retinitis, and high levels can cause discoloration of plants (Lenntech, 2016). Faecal coliforms are an indicator of the presence of harmful bacteria, such as *E. coli*, which causes waterborne diseases like dysentery, typhoid, cholera, and hepatitis A (Titilawo et al., 2015), and may reduce the oxygen level in the environment, causing bad smells.

Mitigation

The safe sources of water for domestic use in Kabushi are boreholes, taps, and shallow wells. This is because water from these sources is protected from exposure to pollutants, unlike from the Kafubu River. Bacteria can be killed by boiling water or adding chlorine before drinking, and it can be prevented from entering shallow wells through runoff by protecting and covering the wells. To avoid uptake of bacteria from crops, vegetables and fruits must be washed in clean water before eating. Application of lime to the soil eliminates aluminium and iron toxicity to produce better crop yields.

4.2.2 Water quality results: Nkwazi area

Box 1.2 outlines the water quality results for the Nkwazi area from Liddle's study in 2013.

Box 1.2 Nkwazi area's water quality results

Nkwazi is a high-density informal community with about 21,402 people. Water for domestic use is from shallow wells, the stream, and kiosks set up by the Kafubu Water and Sewerage Company. After analysis of samples, results revealed that the shallow well and stream (see Appendix H) had high levels of aluminium, iron, manganese, and faecal coliforms, which were over the maximum acceptable values.

Nkwazi area	*Shallow well*	*Stream*	*WHO/USEPA*	*Concern*
Aluminium	444 µg/l	191 µg/l	90 µg/l	☹
Iron	737 µg/l	423 µg/l	300 µg/l	☹
Manganese	87 µg/l	183 µg/l	400 µg/l, 100 µg/l	☹
Faecal coliforms	50 CFU/100 ml	2,200 CFU/100 ml	0 CFU/100 ml	☹
Key ☹	Polluted water (contaminant above maximum acceptable value)			
☹	Polluted water (contaminant above USEPA maximum acceptable value)			

The shallow well had extremely high levels of aluminium and iron, well over the maximum acceptable value (WHO, 2011). The level of manganese in the stream was above the United States Environmental Protection Agency (USEPA, 2012) maximum acceptable value while the shallow well had a concentration slightly below. The stream had extremely high levels of faecal coliforms compared to the shallow well, as shown in the table. Both the stream and well had faecal coliform concentrations over the maximum acceptable value (WHO, 2011).

Probable source of contaminants and significant concerns

Manganese, like aluminium and iron, occurs naturally in the Earth's crust (Lenntech, 2016). Faecal coliform bacteria originate from the intestines of warm-blooded animals. These contaminants enter waterways and wells from the environment via runoff.

Long-time exposure or uptake of significant concentrations of water-soluble forms of aluminium, iron, and bacteria can cause serious health effects and can affect crops, as mentioned earlier in the discussion on box 1.1. Manganese is toxic to humans in high concentrations, can cause neurological problems, and may cause brown spots on leaves and withering of crops (WHO, 2011b; Lenntech, 2016).

Mitigation

Both the shallow well and stream are susceptible to pollution and are not safe sources of water for domestic use because of the presence of contaminants, as shown in the table in box 1.2. Therefore, to protect people from exposure to pollutants water should be drawn from deeper-confined aquifers such as boreholes and from water kiosks, as they contain safe water for drinking. To eliminate aluminium, manganese, and iron toxicity, application of lime to the soil increases soil pH and as a result improves crop yields.

4.2.3 Water quality results: Kaniki area

The water quality results for the Kaniki area from Liddle's study are summarised in box 1.3.

Box 1.3 Kaniki area's water quality results

Kaniki is a low-density informal rural community about 18 km from Ndola city, with a population of about 275 people. Water for domestic use in Kaniki is drawn from a hand-dug shallow well and the stream (see Appendix H). The water quality results revealed a high concentration of aluminium in the shallow well. The well and stream had high concentrations of faecal coliforms, as shown in the table. The concentration of these contaminants was over the maximum acceptable value set by the World Health Organisation (WHO).

Kaniki area	*Shallow well*	*Stream*	*WHO*	*Concern*
Aluminium	245 µg/l	7 µg/l	90 µg/l	☹
Iron	11 µg/l	86 µg/l	300 µg/l	☺
Faecal coliforms	30 CFU/100 ml	201 CFU/100 ml	0 CFU/100 ml	☹

Key		
	☹	Polluted water (contaminant above maximum acceptable value)
	☺	Safe water (contaminant below maximum acceptable value)

Probable source of contaminants and significant concerns

Aluminum and iron contribute to the properties of soil as they occur naturally in the Earth's crust (Lenntech, 2016). Faecal coliform bacteria comes from the gut of warm-blooded animals (Titilawo et al., 2015). These contaminants enter water sources from the environment via runoff and may affect human health and crop yields, as mentioned earlier in the discussion for box 1.1.

Mitigation

In general the stream is a safer source of water for domestic use because the shallow well had a high concentration of aluminium. Water from the stream can be made safe from harmful bacteria by boiling or adding chlorine to kill bacteria. To safeguard human health from exposure to aluminium, water should be drawn from the deeper aquifer as it contains safer water compared to the shallow well. Application of lime to the soil eliminates aluminium toxicity to produce better crop yields.

The water quality results, probable sources of contaminants, significant concerns, and mitigation options can be beneficial if information about these are made available to the residents of Kabushi, Nkwazi and Kaniki communities. To ensure that the knowledge produced from Liddle's study is beneficial to residents, I returned to these communities to address issues concerning culture, effective participation, and sharing and ownership of knowledge produced in research.

4.3 Decolonising methodologies

Mutua and Swadener (2004) refer to research as a colonising construct. This is because the relationships that occur between the researcher and participants often reflect domination and reinforce exploitation and marginalisation of the knowledge produced, typical of colonial research. This is evident through the often-intrusive attitude of researchers and discrepancies in authority where the rights and knowledge of communities are set aside via non-participatory methodologies. The researcher benefits from achieving research goals and research findings as they may get recognition from publishing an article in a journal or conference paper, present their findings at a conference, and/or write their thesis or book (Sommer, 1999). Unfortunately, the participants are left wondering what the findings were; this does not enable discussion of the meaning and application of research findings to empower the marginalised and oppressed. H. Scheyvens et al., (2014) describes marginalised people as individuals who are much poorer than others, a minority ethnic group, or children. The people from the communities involved in this study are poor, and they have little or no

control over the water quality issues and other research projects affecting them. Research projects are often conducted with marginalised people in an oppressive manner, as discussed by Young (2009), who further explains that oppression in research can occur when people are exploited as a source of information for the benefit of the researcher.

Unlike colonial research, post-colonial research is founded on open, more democratic and equal relationships; hence, according to Dowling (2016), it is a reaction to and rejection of colonial research. The methodologies used are designed with the aim of contributing to self-determination and the benefit of others. This is achieved by valuing the rights, perspectives, knowledge, desires, and concerns of others, including accesses to research findings to allow for discussion of their meaning and application to empower participants. An extra step has been made via decolonising research, where the research process and findings are used to stop unequal power relationships, social structures, and unfair representations created and retained by colonialism and neo-colonialism (Dowling, 2016). Decolonisation as a research process is an approach that takes in the views of the oppressed and marginalised by allowing them to "communicate from their frames of reference" (Chilisa, 2011, p. 15). For this reason, Tuhiwai Smith (2012) calls for decolonising methodologies to allow for the recognition and undoing of the damage caused by colonial authority. A social change in colonial relationships is achieved by reclaiming knowledge, language, and culture. In addition, indigenous views, procedures, and methods of knowing and learning are embraced in decolonising methodologies as these are guided by the values and knowledge of the Indigenous people being researched (Bartlett et al., 2007; Brooks, Poudier & Thomas-MacLean, 2008).

Decolonising methodologies are approaches created with the aim of allowing for self-determination in indigenous research, which according to Kaomea (2004) should be about healing and empowerment. In decolonising methodologies, the approach or method used is very important and is expected to be respectful, enabling, healing, and educative in order to encourage people towards self-determination (Tuhiwai Smith, 2012). For example, Kaupapa Māori approaches aim to effect positive change for the individuals or communities involved in research, and these benefits do not need to be immediate. However, the expected short-term or long-term benefits of the research or project design must be included and clearly stated.

Tuhiwai Smith (2012) argues that cultural protocols, values, and behaviours are fundamental parts of indigenous methodologies which automatically need to be included in the design of the research and discussion of results. Hence, she recommends the need for developing different approaches and methodologies regarding research with Indigenous peoples to ensure that it is more respectful, ethical, sympathetic, and useful. Furthermore, she recommends the use of culturally appropriate methods which do not involve racist attitudes and practices, and are not based on ethnocentric beliefs and exploitation. For this reason, Indigenous activists strongly argue that research should not be conducted if the views of Indigenous communities are not included or if their lives are regarded as insignificant.

4.3.1 Justification for use of decolonising methodologies

I used decolonising methodologies for the following reasons. To begin with, this study is a response to the concerns and needs expressed by residents who have been participating in water research projects in Ndola. To empower the research participants and their communities I gleaned[2] the research question from them. The study was designed to ensure that the voices (concerns) and needs (access to water quality results) of the participants are heard and to allow the participants to lead the discussion and to choose the method which is appropriate to them for sharing research findings with them. I was not able to completely have the participants direct the research, as is the case in indigenous methodologies, due to the one-year thesis time constraint, so I also used Freire's framework to guide me in providing research knowledge to the participants from affected communities.

Secondly, in development fieldwork, H. Scheyvens et al., (2014) recommends using several approaches, including indigenous methodologies, used in decolonising methodologies. Indigenous communities are effectively involved and are empowered via indigenous methodologies as they are informed by indigenous knowledge, values, and processes which encourage them to be self-determined (Tuhiwai Smith, 2012).

Thirdly, decolonising methodologies promote the use of the qualitative approach and more innovative methods in research (Bartlett et al., 2007). I used a qualitative approach (semi-structured interviews and focus group meetings) and innovative methods (stories and proverbs) for this study. Decolonising methodologies go beyond current dominant Euro-western research methodologies and means of disseminating findings. Swadener and Mutua (2008) recommend alternative ways such as the use of narratives, stories, music, drama, and

[2] I set the research question based on what the participant communities wanted which is access to water resource knowledge

arts as methods in research because they go against the use of Euro-western, modified conventional, and positivist paradigms.

Fourthly, decolonising methodologies apply not only to research concerning the geopolitical experience of colonisation but also where colonising research approaches are being used (Swadener & Mutua, 2008). For example, decolonising research approaches may be used to carry out research with non-western, marginalised, and oppressed people such as ethnic minority groups and people living in poverty, as is the case with participants in the focus group meetings and semi-structured interviews in this study.

Fifthly, decolonising methodologies address the distrust and damage that has been created by previous research in Indigenous communities (Brooks et al., 2008). In this study respect, reciprocation, and collaboration were maintained to help develop trust between me and the participants from local communities. This is because decolonising methodologies enable local researchers to work collaboratively with their community, as was the case with this study, and to work among other local researchers and with outsider researchers to achieve mutual goals using anticolonial methods, an important feature of decolonisation (Swadener & Mutua, 2008).

The sixth reason for using decolonising methodologies is because these endeavour to change past research practices which have offended or hurt Indigenous communities (Liamputtong, 2010). Therefore, to reveal concealed biases and prevent misrepresentations and exploitation, a decolonising methodology deconstructs research by allowing application of both traditional and scientific methodology from research design to dissemination of research findings (Brooks et al., 2008). In this study, I used both traditional and scientific methods to get a better understanding of the experiences, perceptions, and preferences of the participants, and most importantly, the benefits or usefulness of the study for the communities involved.

Decolonising methodologies attempt to empower Indigenous communities while respecting their culture and traditions (Brooks et al., 2008). Therefore, I used methods and skills tailored to meet the traditions, languages, and needs of the communities involved in the study. Another scholar, Liamputtong (2010), agrees with using culturally appropriate and sensitive methods, and argues that the methods must be carried out by both the decolonising researcher and the research participants. This allows for the knowledge gathered about development issues to be shared and owned by the local people and not the practitioner (McDavitt et al., 2016). This is achievable if the account of the local people is taken in when the problem is

identified, the policy formulated, and the project implemented, hence putting the poor, destitute, and marginalised at the centre of the development processes and policies.

For example, in New Zealand when conducting research with Māori, the decolonising methodology of Kaupapa Māori is used. Kaupapa Māori is an approach which involves culturally appropriate methodologies and protocols in research (Tuhiwai Smith, 2012). According to Pihama (2001), Kaupapa Māori theory should challenge injustice, reveal inequalities, and pursue change. However, Bargh (2011) argues that the curiosity of Indigenous researchers using Kaupapa Māori is restricted to issues directed by their communities, and this limits research or projects. Similarly, Te Punga Somerville (2011) considers Kaupapa Māori as diminishing instead of space-opening at times because some researchers restrict themselves to Māori writers. Another limitation is that some discussions in Kaupapa Māori may not in fact be beneficial to individuals being researched (Bargh, 2011). However, such discussions can offer others a useful perceptive and may yield long-term benefits.

Therefore, to achieve the desired benefits, Eketone (2008), recommends focusing more on a common issue, which is developing and advancing using Māori knowledge, values, and processes. The limitations discussed by Bargh (2011) and Te Punga Somerville (2011) regarding the use of the Kaupapa Māori decolonising methodology in the New Zealand context may occur in other Indigenous communities where an indigenous decolonising methodology is applied. These limitations can affect the development of Indigenous communities. However, focusing more on the development and advancement of Indigenous communities using indigenous knowledge, values, and processes, as recommended by Eketone (2008), will lead to achievement of both short-term and long-term benefits.

In the current study, I was not restricted by the participant communities because poor water quality is a common concern that needs to be focused on to enable the development of affected communities in Ndola. Hence, I focused on returning poor water quality results as they relate to and are beneficial for people in the affected communities. Furthermore, the conversations with key informants via semi-structured interviews and the discussions held with participants via focus group meetings were interesting, useful, and beneficial to the communities with poor water quality.

Finally, I did not consider myself as an outsider when I held semi-structured interviews and focus group meetings in communities in Ndola because Ndola is 58 kilometres from my home city Kitwe. I am very familiar with the area and the water quality issues the communities have been facing from Liddle's study in 2013. I also did not consider myself as an insider even though I was born in Ndola and lived there for a few years before my family moved to Kitwe. I do not live in the affected communities and hence have not experienced the water quality issues being experienced by residents. Even though I am very familiar with the communities and the water quality issues they face, I adhered to ethical procedures and conduct when returning the water quality results. This was another reason for using decolonising methodologies: they uphold the highest ethical considerations of participants in research.

4.4 Ethical considerations

Carrying out research in developing countries can present a plethora of ethical issues (Banks & Scheyvens, 2014). These include unequal power gradients, exploitation of participants, and one-sided generation and ownership of knowledge. Hence researchers contemplating fieldwork in the developing world should seriously consider the ethical issues which may arise in all stages of research. This enables researchers to adhere to ethical principles from the beginning of the project through to the end. In addition, it is morally right for the researcher to be considerate of the needs and rights of participants, as it enables them to act in a more sensitive and respectable manner. As a result, a mutually beneficial relationship is built between the researcher and the individuals from communities participating in the study.

This study involved interaction with people as semi-structured interviews and focus group meetings were held. To protect the rights of the participants, the ethical procedure approved by the Human Ethics Committee of the University of Canterbury was adhered to (see Appendix A).

For high-literacy participants – those key informants from organisations that provide water to communities in Ndola – the procedure involved several steps. Firstly, the individual was given an oral summary of the study, to enable them to either accept or decline involvement in the study. Secondly, the individuals were provided with an information sheet and a consent form. The information sheet outlined the project's aim, background information, the methods used, and the information required, while the consent form further explained that participation is voluntary and reminded the individuals about the benefits and risks of participation and that the information gathered from them was confidential (Henn, Weinstein

& Foard, 2006). At this stage the consent form gave the participant another chance to withdraw from the study; this was done to ensure voluntary participation and the protection of the participant's rights.

After the participants confirmed that they wanted to take part in the study by signing the consent form, I asked for their permission to record the semi-structured interviews using an audio recorder before commencing the interview. At the end of the interview I read through the notes taken during the interview for the participants to confirm the information I gathered.

For low-literacy participants from low-income communities, the ethical procedure was similar to that of the key informants but was done orally. Firstly, I explained an outline of the study, and then interest in taking part was shown by turning up to the focus group meeting. Secondly, before the meeting began I read an oral information script and consent script for individuals to give or note consent. Individuals who had concerns had an opportunity to discuss their concerns and pull out without judgement.

Thirdly, after noting of consent of individuals I then asked for the participants' permission to record their responses to questions and their views regarding the water quality results at the end of the focus group meeting using an audio recorder. Then I read through the notes to confirm participants' experience of the study in 2013, which method they preferred, and why, to avoid collection of incorrect data. I admit that some of the methods that I explored to share the research findings from Liddle's study were probably culturally inappropriate[3]. So, the methods were mentioned in the oral information summary before starting the focus group meetings in order to give the individuals an opportunity to decline or give their consent to participate.

This study was designed to ensure that the participant communities benefit from the study and not just myself (by using the information I gathered from them to write this thesis). To achieve this I informed the key informants that after completion of this study they will receive a copy of the thesis and the residents from the three participant communities will have a meeting where I will share the findings of this study. This is a promise that I will fulfil not only as my ethical responsibility but as a way of ensuring that the participants benefit from the current study. Residents from participant communities will benefit by having access to the current study's research findings via the method that is appropriate and will put them in a position where they can exercise their rights by demanding that researchers use the

[3] Some of the methods used might not be the cultural norm of the participant communities

"appropriate method" to share research knowledge with them. Taking back the findings from this study is important because the friendships, respect, integrity, and trust that was built between me and the participants will be maintained.

4.4.1 Participant selection

The participants for both the semi-structured interviews and focus group meetings were selected by dint of their having been participants and residents of the communities studied by Liddle in 2013. Therefore, the participants were selected because they participated in the study in 2013, and they were capable of providing valuable, significant, and varied information relevant to the research question[4] (Tong, Sainsbury & Craig, 2007).

4.5 Methods

The method used in the field must be appropriate to achieve the aim of the study, which is to determine the appropriate method for taking back water quality results to communities in Ndola. The fieldwork was conducted in Ndola, the headquarters of Copperbelt Province, Zambia. Semi-structured interviews were carried out with key informants from organisations that are involved with water supply – the NGO Seeds of Hope and the Kafubu Water and Sewerage Company – and individuals from Kabushi, Nkwazi, and Kaniki communities (see figure 6).

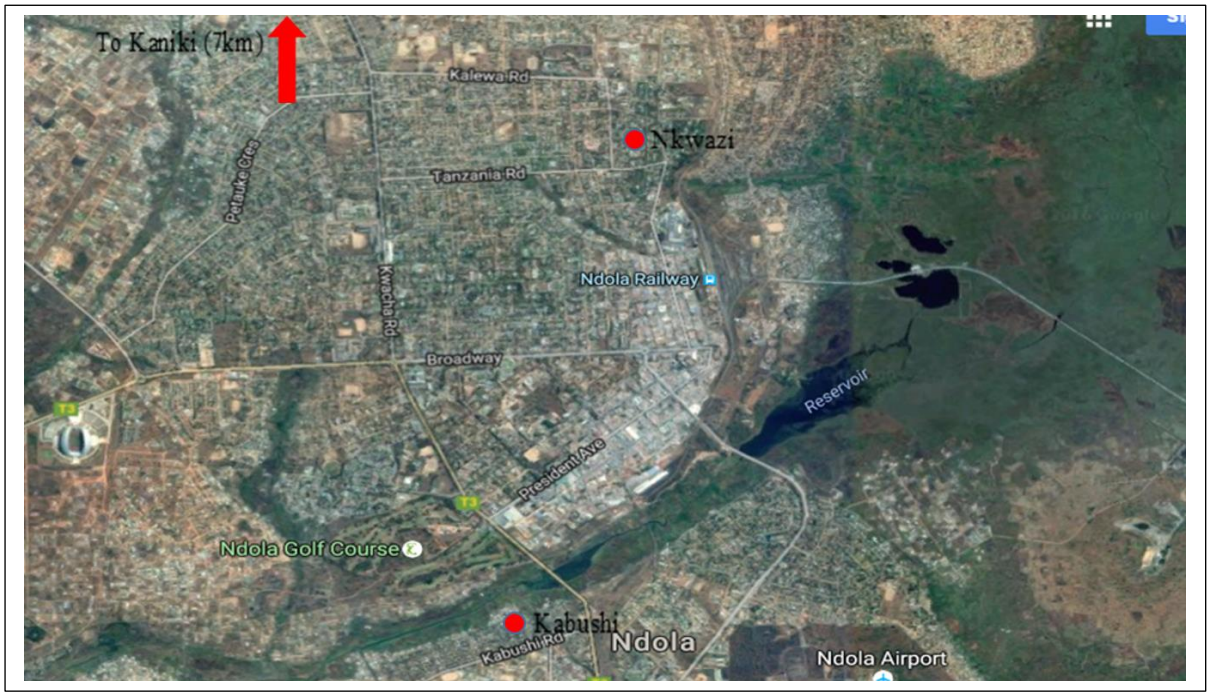

Figure 6: Location of study areas in Ndola (Source: Google Maps).

[4] "What method is appropriate for returning water quality results to communities facing water quality issues in Zambia?"

Focus group meetings were also held with residents from these three communities. The questions asked during the semi-structured interviews were based on individuals' experience with water research projects and the discussions in the focus group meetings were designed based on the research findings (secondary data) of the study conducted by Liddle in 2013.

4.5.1 Semi-structured interview

I used semi-structured interviews because they were an appropriate method of eliciting information from participants, who were free to express themselves in their own words about what they felt is important regarding their experience with Liddle's study in 2013. Fylan (2005) defines the semi-structured interview as a conversation or verbal exchange where an individual (the interviewer) asks another individual (the interviewee) questions to get information about a particular issue. The interviewer has a good understanding of the topics to be covered and set questions to elicit the information they want while allowing the interviewee to fully express themselves about issues they think are important (Cameron, 2016). The interview method best allows for social processes to be explored and questions of how and why to be answered in an informal environment (Brah & Shaw, 1992). In addition, interviewing allows participants to answer questions further, giving them more control over the interview, and so they dictate the contents of the data and may raise other issues which the interviewer may have regarded as irrelevant.

For this study, 41 people were interviewed. These included four key informants from organisations – three from Seeds of Hope and one from the Kafubu Water and Sewerage Company – whom I recruited by visiting their work places on 21st June and 9th July 2016 respectively. While these four key informants were willing to participate in the study, others were reluctant as they felt that they were not experts in the type of information I was interested in. The response was different in Kabushi, Nkwazi, and Kaniki communities because many individuals were interested in participating in the study. However, I only interviewed 37 people from the focus group meetings in these communities, up to a point where no new findings were emerging (O'Leary, 2010).

The semi-structured interviews were carried out by visiting the communities where the focus group meetings were held on 11th and 12th July 2012. In the semi-structured interviews, it took the participants 20 to 30 minutes to thoroughly answer the questions. I used an audio recorder to record the semi-structured interviews and took field notes to record the

participants' conduct and make notes about the environment so as to aid in analysis and discussion of data.

While the questions asked were predetermined, their order and wording were changed and additional questions added depending on what seemed most appropriate. The questions asked were:

1. Tell me about a time when you participated in a study concerning water issues.
2. [Prompt] Describe your experience in research projects about water resources.
3. [Prompt] What kind of information did you get out of the research participation experience?
4. What do you know about your water?
5. How do you know this?

The semi-structured interviews were ideal for gaining information about participants' experience of water-related research projects while the focus group meetings gave me more insights about the methods that the communities preferred for the sharing or communicating of water quality results with them.

4.5.2 Focus group meeting

Stewart-Withers, Banks, McGregor and Meo-Sewabu (2014) describe a focus group as a discussion concerning a particular issue by a group, where the researcher moderates the discussion but allows the group to freely explore the issue from different views. Focus groups involve a small group of people of usually 6 to 12 participants who meet to discuss a particular issue set by the researcher (Cameron, 2016). Focus groups are similar to semi-structured interviews because both methods involve verbal exchange or dialogue and their informal manner allows the participant to respond openly in their own words instead of merely with yes or no responses (Cameron, 2016). Zeigler, Brunn and Johnson (1996) state that focus groups provide insights that may not be revealed through methods such as questionnaires or individual interviews.

I decided to use focus group meetings in this study to get insights from participants regarding what method they considered appropriate for returning or sharing research findings with them. This is because the focus group method is one of the methods that can be successfully used to share results with research participants (Agar & MacDonald, 1995; Berg, H. Lune, & H. Lune, 2004). Participants for the focus group meetings were recruited by visiting Kabushi, Nkwazi, and Kaniki communities. Before the first meeting I carried out a trial focus group in

Kabushi on 8th July 2016 with six participants to ensure that the focus groups would be successful. I did this because I had initial concerns about people remembering me from Liddle's study in 2013 and about how to successfully recruit people to participate in the meetings.

Participant recruitment concern

In July 2016, I returned to Kabushi, Nkwazi, and Kaniki communities to conduct focus group meetings with a lot of worry because I was concerned that individuals from the communities would not remember me from when I assisted Liddle with her fieldwork for her study in 2013. So, I ensured that I visited the same homes I visited with Liddle in 2013.

"Do you remember me?" I asked, and to my surprise and relief most of the participants did. "Yes, I remember you," they replied. "Well, if you do remember me, what is it that you remember about me?" I asked. They replied, "You came to my house with a woman from another country and asked questions and also collected water samples from my well."

I was received well, but some individuals had mixed feelings because they thought that I was back in the area to collect more data. When I explained to the individuals about why I was in their community, which was to bring back water quality results from the study conducted in 2013, they responded, "You have come back to tell us about the results from the water samples you collected in 2013! Wow! This has never happened in this community before! Give me a few seconds – I must call other people to come and hear about the water quality results."

Their countenance changed: they were surprised and excited, and so grateful that they immediately started calling or yelling and summoning their neighbours, friends, and individuals from the community who use the water sources from which the water quality results were from. Within a few minutes, I had several people seated, anxiously waiting to participate in the focus group meeting. This surprised me because my plan was to visit the communities initially to invite people to attend the focus group meeting and request a suitable time to come back and conduct it.

***

The first focus group meeting was held on 11th July 2016 in Kabushi with 15 participants, the second in Nkwazi with 10 participants on 12th July 2016, and the third in the afternoon on 12th July 2016 in Kaniki with 12 participants (see figure 7). Each of the three focus group meetings ran for over two hours to allow for the four methods I developed for communicating water quality results to be conducted.

Figure 7: Focus group participants from Kaniki. Source: Author

4.5.2.1 Methods used in focus group meetings to take back water quality results

The methods included reading a brochure, watching a video, giving a presentation, and holding a discussion about the water quality results at each of the three focus group meetings. Two hours was adequate to encourage participants to openly express their views (Sussman et al., 1991). At the end of the meeting the participants where asked what method they thought was most appropriate for communicating water quality results and were recorded using an audio recorder. The water quality results for Kabushi, Nkwazi, and Kaniki discussed at the beginning of this chapter were developed into four methods for each of the three communities. The order of the methods used in communicating the water quality results at each focus group meeting was changed to avoid participants being biased when choosing the method they prefer.

- Brochure

I developed a brochure in simple English and translated it into Bemba, a local language spoken by the majority of people in the Copperbelt Province. A brochure is a paper which is folded into a leaflet containing well-written information for a targeted audience (Snyman, 2002; Morris & Stilwell 2013). The brochures were handed out in English or Bemba, depending on the participants' preferences, at the focus group meetings for each participant to read the water quality results, their meaning, and the application of the findings from Liddle's study. I used brochures because they are a relatively simple and cheap method of providing well-written, precise information (see Appendix G).

- Video

To make a short video, I used pictures and audio in Bemba. I recorded over the pictures information about the water quality results from Liddle's study, the significant concerns or meaning in those results, and the application of the findings to mitigate the water quality issues being faced. I showed the video using my laptop. Showing a video was ideal for a focus group meeting because it is a great way of getting information or a message across to a group of people or a large audience. The videos can be viewed via these links [5].

- Presentation

I used diagrams and pictures to explain, in Bemba, the water quality results from Liddle's study and the significant concerns and mitigation options. I used presentations because they are cheap and easy to carry out: one only needs a few diagrams and pictures to effectively communicate information (see Appendix H for presentation notes and pictures).

- Discussion

The water quality issues that occur in the community, the water quality results from Liddle's study, and the significant concerns and mitigation options were discussed in the focus group meeting by the participants, along with me, in Bemba. Discussion was used because it was the cheapest and best way of engaging participants and enabling them to explore the water quality issue from every angle. Diagrams and pictures were also used in the discussion to aid

[5] https://youtu.be/hxe9AojZeWY, https://youtu.be/62bcjrPxqjg, and https://youtu.be/aB1kqbbMITw.

participants in expressing themselves thoroughly (see Appendix I for notes on the water quality issues discussed and a link to the figures used in each of the methods).

Overall, I conducted semi-structured interviews and held focus group meetings because these approaches are encouraged in decolonising methodologies.

4.5.3 Practicing a decolonising methodology

I practised a decolonising methodology by involving participants in dialogue via semi-structured interviews and focus group meetings. This enabled co-creating, sharing, and co-ownership of knowledge about the ideal method for returning research findings in Ndola (Tanno & Jandt, 1993). Secondly, the experiences, views, and preferences of the communities were taken into account, and as a result, trust was created and the damage caused by past offensive colonising practices was repaired, as is expected and practised in decolonising methodologies (Brooks et al., 2008). Thirdly, adhering to cultural procedures is highly recommended in decolonising methodologies (Chilisa, 2011). I approached the communities in a respectful and sensitive manner. I used Bemba, a local language used by most people in the communities. I adhered to cultural expectations regarding my conduct and dress, ensuring that I was dressed in a culturally appropriate manner by not revealing or exposing my body (I wore a chitenge, a traditional wrapper worn around the waist by women).

Fourthly, I practised decolonising methodologies by focusing on the benefits that the communities will get from the start of the research project and during fieldwork. I shared research findings (water quality results, significant concerns, and mitigation options) from Liddle's study with participant communities in Ndola. I continued focusing on the benefits for the communities at all the stages of research including writing, discussion, and sharing or returning of findings after completion of the study, which is often not done by researchers. Sharing research findings with communities that participated in a study is a feature of decolonising methodologies (Tuhiwai Smith, 2012). However, it is possible that the methods used in this study have limitations that may affect the results.

4.5.4 Limitations of the study

This study is set in Kabushi, Nkwazi, and Kaniki communities in Ndola. These communities are experiencing specific development issues, including challenges in accessing knowledge produced from research and adequate access to safe water for domestic needs. Residents of these communities have a different cultural orientation and background from other cultures in Africa and around the world.

This research is limited to the experience and preference of participants from these communities in Zambia, which could remain the same or change in the future. Therefore, the study is limited because it is specific to the participant communities, their culture, and the time period when the research was conducted; the experience and preference of residents from other communities in Africa and around the world could be different from those of participant communities in Ndola.

Although I got permission to conduct semi-structured interviews with employees from the Kafubu Water and Sewerage Company (KWSC), the response was discouraging because the employees were reluctant to participate in the study. So, I went back to the office, where I obtained the letter permitting me to conduct semi-structured interviews. The KWSC employee I found in the office contacted a few employees on my behalf and managed to set up a meeting with a water quality specialist, the only key informant I interviewed from this organisation, compared with Seeds of Hope, where I interviewed three employees. I gave the water quality specialist from KWSC ample time in order to glean the most information possibled about his experience with participating in water research projects.

Another major limitation is that the focus group meetings involve having a moderator who defines, guides, and keeps the participants focused on the topic or agenda (Agar & MacDonald, 1995). However, the moderator can disrupt the group, and depending on how sensitive the topic is, some participants may be embarrassed or uncomfortable to express themselves. To ensure that I (the moderator) did not disrupt the focus group participants, I gave them enough time (a minimum of two hours) to enable each participant to share their experiences with participating in water research, and to criticise or approve of the four methods I used to share water resource knowledge with them. I also permitted them to express their feelings (anger or happiness) about participating in water research projects. At times, some participants would divert from water quality issues and their experiences with water projects. For example, a man brought up the issue of too many stray dogs in their

community; this diverted them from the water-related issues being experienced. I then asked them to return to water issues.

A few individuals wanted to speak more than others, so I had to encourage all the participants to participate and told them that their experiences, ideas, and any water-related issue they share matters. This way even the more reserved or quiet participants were able to contribute openly. However, the individuals who are more outspoken than the others could still speak more and control or affect the ideas of those who spoke less (Sussman et al., 1991). Another limitation is the range of topics that can be researched effectively in focus group meetings as participants share or disclose their experiences, views, or concerns. Water quality issues and the experiences of participants from affected communities is a sensitive topic because residents from these communities are angry with researchers; yet, they are willing to openly share their concerns and criticise their exploitation. Compared to topics such as sexuality, water quality issues is not a topic that would embarrass participants, so it was easy for them to participate openly without being embarrassed.

Overall I understand that it is possible that I did not capture all the participants' experiences, opinions, and concerns regarding water quality issues being experienced and their experiences with water research projects. Therefore, the information I collected and analysed may not reveal all angles of participants' experiences with water research projects, their opinions and concerns regarding poor water quality issues, and their preference concerning the method that is appropriate to share water research knowledge with them.

A final limitation is that this study involves gathering and analysing information from participants' experiences, perspectives, opinions, and concerns, and these vary from one individual to another. Due to multiple sources of data it is possible to arrive at inconsistencies, which according to Patton (2002) does not weaken the evidence as it is an opportunity to reveal more profound meaning from the information. Hence, I used triangulation to check and establish validity across different sources of information and approaches. I used triangulation as a means of attempting to increase confidence in the findings of the study, which helps in understanding local communities' experiences with water research projects and provide a clear understanding of unequal access to scientific knowledge about water quality by local communities in Zambia.

To increase the validity of the study, I gained insights from key informants (water resource experts) via semi-structured interviews and from residents in participant communities via focus group meetings regarding their experiences, perspectives, opinions, and concerns with water research. To avoid investigator and theoretical biases I attempted to maintain objectivity, and hence all the information collected, analysed, and presented as results is based on the participants' experiences, perspectives, opinions, and concerns (Thurmond, 2001). In addition, I studied several different theories and approaches regarding inequality in research and I have discussed the study's results based on the theories and approaches I reviewed.

4.5.5 Data analysis

The data I collected during semi-structured interviews and focus group meetings consists of audio recordings of participants' statements. To analyse the audio recordings I transformed participants' statements into written words; I typed participants' statements from the semi-structured interviews and focus group meetings. This is known as transcription, a process where the verbal interaction is made into a written account (Lapadat & Lindsay, 1999). However, transforming speech into words is a challenging process because some words, vowels, or sounds may be omitted, sentences may be incomplete, words may overlap, and the audio recording quality may be poor or have background noise (Ashmore & Reed, 2000). To ensure that I did not change the intent or emphasis of the responses from the participants, I took note of the mood, tone, and surroundings of the participants when conducting the semi-structured interviews and focus group meetings (Wengraf, 2001). I listened to the audio recordings, wrote every word that was spoken, and carefully determined where and when punctuation was needed.

The transcripts were compacted to better understand the significant segments and to enable me to identify key themes; this process is known as coding (Stewart-Withers, et al., 2014). To achieve this, I read and reread the transcripts to understand and identify themes or categories. Identification of significant themes allows for developing a framework to present data and hence better communicate or discuss results. The themes centre on particular words, incidents, or conduct of the participants (Pope, Ziebland & Mays, 2000). I further refined or reduced the number of themes by grouping them together based on the analytical and theoretical ideas used in this study (Pope et al., 2000).

To identify or establish the relevant theme to which a participant's statement relates, I compared it with each theme using a coherent and systematic approach (Pope et al., 2000). This process was comprehensive because the themes reflect not only similarities but also differences in participants' statements. To select sections from participants' statements I printed all the transcripts, and using a highlighter, I highlighted significant quotes and statements that relate to the themes. I then cut the significant quotes and statements and pasted them under the related theme using a Word document on a desktop computer. This process helped me develop in-depth knowledge of participants' statements about their experience with water projects and made it possible to select key themes to present as results.

4.6 Conclusion

This chapter has described in detail the methodology used to collect data in this study. A background of Liddle's study is included because the water quality results I returned to the communities are from her study. In this study, I used decolonising methodologies appropriate for this study, which were Freire's framework and indigenous methodologies. This enabled me to investigate the experience of participants regarding water research projects and the method preferred by them for taking back research findings to them. A detailed description of the ethical considerations, selection of participants, methods used to investigate the experiences of participants regarding water research projects, and different methods used to take water quality results to back affected communities in Ndola are included. In addition, a thorough explanation of how the data I collected were analysed is given. Chapter 5, which follows, will deal with the results obtained using the methods described in this chapter.

5. Communities' experiences with water research projects in Ndola

5.1 Introduction

Over the past several years, individuals (key informants) and residents of Kabushi, Nkwazi and Kaniki communities in Ndola have been participating in water research projects. Their experience with these projects has been affecting them because they do not have control over the projects, which are conducted using methods that deny them effective engagement. Researchers often use dominant Euro-western ideologies and methods to conduct studies about water resources in their communities. Hence, research has not achieved the desired result because it has failed to contribute to local development, particularly to benefit people living in poverty, who are the ones most affected by water issues. This chapter presents the experiences of key informants and residents of the three communities with water research projects. This will reveal the answer to the study's research question, *What method is appropriate for returning water quality results to communities in Ndola, Copperbelt Province, Zambia?*

The experiences presented in this chapter were provided by key informants and individuals from communities. The key informants I interviewed were employees from the Kafubu Water and Sewerage Company and Seeds of Hope, an NGO. The Kafubu Water and Sewerage Company is a commercial utility that provides potable water to communities in Ndola. Seeds of Hope has been working with communities, particularly people living in poverty, by providing biosand filters, setting up hand pumps (boreholes) in communities with challenges in accessing water, and holding sessions where water sanitation and hygiene issues are discussed. The individuals that participated in the focus group meetings were from Kabushi, Nkwazi and Kaniki communities.

The semi-structured interviews were conducted to gather information on participants' experiences with research projects about water resources and participants' knowledge about water quality in Ndola. The overall aim of the focus group meetings was to experiment with using the brochure, video, presentation, and discussion methods to bring data back to communities from a water quality project carried out by Elizabeth Liddle in Ndola in 2013. To understand what the key informants and individuals from the three communities think about participating in water research projects, this chapter discusses the key themes from their experiences in water studies and the knowledge they have about water quality in Ndola. For the focus group meetings, a brief account of the different methods used to communicate

water quality results from Liddle's study in 2013 with participant communities is given. The key themes from participants' statements gathered from the focus group meetings are included. Significant statements and stories from the participants are directly quoted and included as evidence. A summary of the study's findings is included at the end of this chapter to highlight key themes that will be discussed further.

5.2 Communities' experiences with water research projects

When people were asked (in semi-structured interviews) about their experiences with water research, all the key informants answered that the information or knowledge they have about water quality and quantity is from their work. They also said that they have access to information about water resources when they assist researchers during fieldwork and the analysis of water samples. However, after completion of research most of the key informants said that they do not have access to study findings or knowledge produced from the research. Residents from local communities that have participated in water research projects in Ndola answered that they do not have access to the knowledge produced from water studies.

The information they have about water quality is from their own experiences, including observing particles or insects in the water, unacceptable taste or change in water colour, and incidence of waterborne diseases (diarrhoeal diseases), including cholera, dysentery, and typhoid, in their communities. From the participants' statements, I have drawn out four key themes: knowledge production, lack access to knowledge produced, imposition of solutions, and studied as objects and source of data (see figure 8).

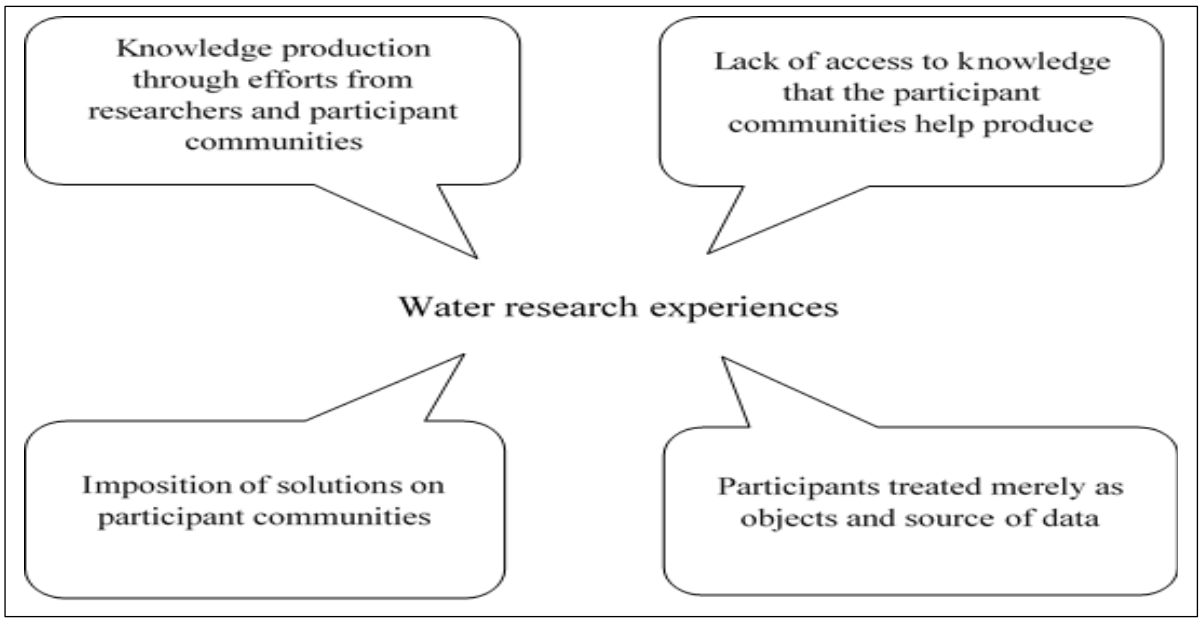

Figure 8: Key themes in communities' experiences with water research projects in Ndola

5.2.1 Knowledge production

The key informants do not just participate as interviewees in water resource projects: some have also assisted researchers by giving information about other potential participants and introducing researchers to residents in communities where fieldwork is to be conducted. Others have worked with researchers to collect data, for example, to conduct questionnaire surveys and collect water samples for analysis. The key informants and researchers learn the different ways of conducting fieldwork from each other. The information and various assistance or work undertaken by key informants with researchers allows for co-production of knowledge about water resources (see figure 9).

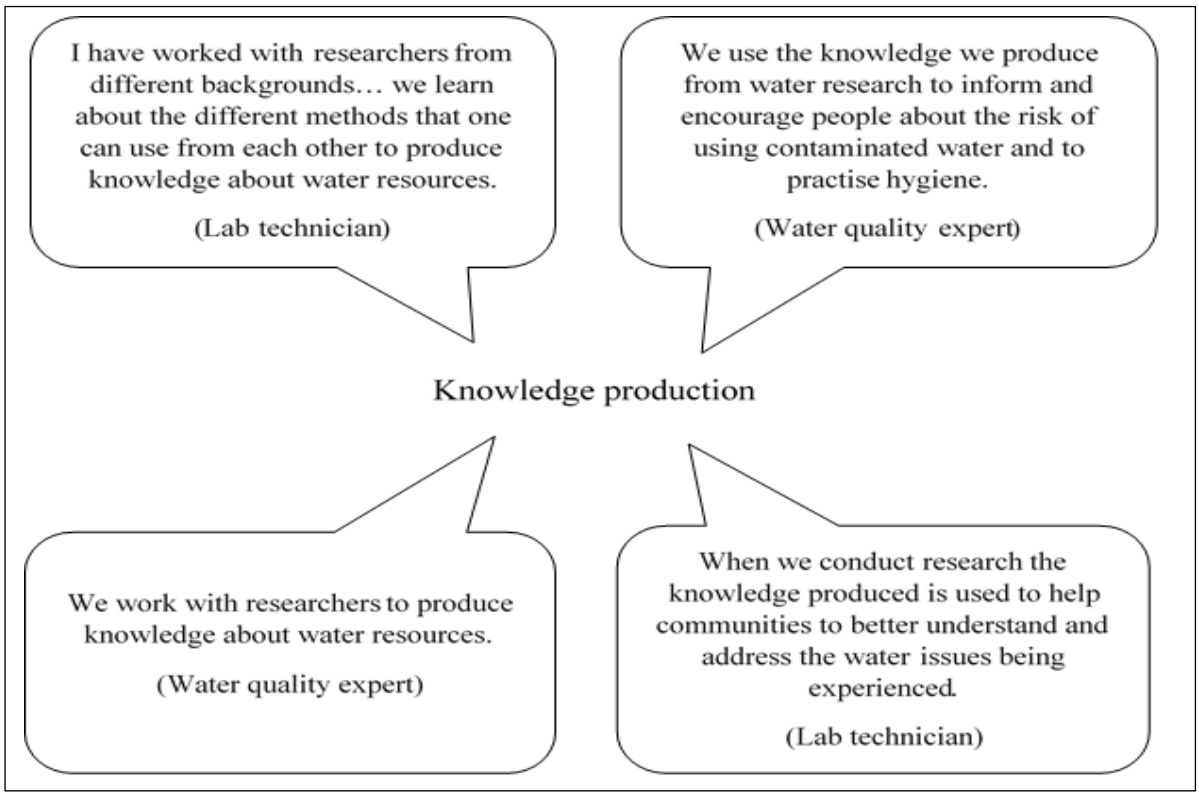

Figure 9: Knowledge production

The following two quotations show that key informants and researchers work together to co-produce knowledge about water resources in Ndola:

> We get experience as we do our work… We do our work in a particular way… When researchers come and do it in a different way, we learn from them, and they also learn from us. In this way, we produce knowledge about water resources together. (Water quality expert)

> In my experience, if one has certain information about a subject matter or how they do their work, one flows with it. But one also learns other methods as they work with researchers from different backgrounds to produce knowledge about water resources. (Lab technician)

The knowledge produced from water research is considered important by key informants because it can be used to prevent diarrhoeal diseases and safeguard the health of people living in communities with poor water quality. People can use the knowledge to prevent deaths of children under five years old. This is because 13% of deaths of children under five years in Zambia is due to diarrhoeal diseases (World Health Organisation, 2013).

Two key informants from Seeds of Hope gave examples of the importance of sharing knowledge produced from research with local communities. The water quality expert said:

> We used the knowledge produced from the research we conducted by informing people about the risk of using water storage containers to perform other house duties. People use the storage container to draw water, to carry water to the house for filtration using biosand filters, and then use the same container for storage. So, we encouraged individuals to practise hygiene (clean water storage containers with clean water before filtration and storage of water). We also encouraged people to keep water sources clear, to stop urinating or bathing at or near the hand pump and other water sources to prevent contamination of water.

The lab technician added:

> Water can be contaminated by using a container to draw water from a contaminated well and the same container for storage after filtration. Filtration is useless if water is not stored well. Residents thought that using the biosand filters will treat their water. They did not understand that after filtration water can be re-contaminated during storage (hence the regular stomach aches or incidences of diarrhoeal diseases).

5.2.2 Lack access to water resource knowledge

Almost all the key informants spoke positively about their interaction with researchers and their experience with water research projects. However, the key informants and residents from the local communities said that after researchers complete their research, access to the knowledge produced is not subsequently ensured (see figure 10).

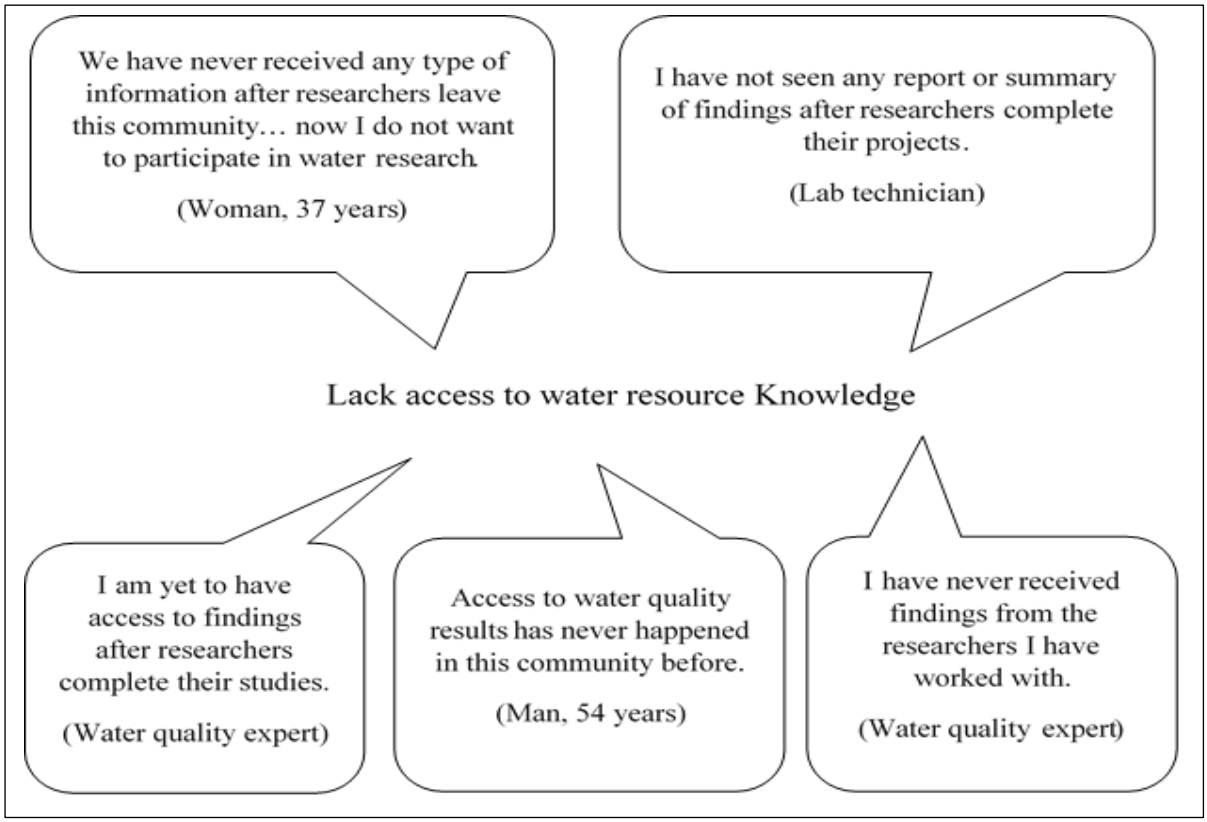

Figure 10: Lack access to water resource knowledge

Many local people in Ndola do not want to participate in water research projects because they do not see any benefits in relation to addressing the water quality issues in their communities. Three key informants made the following statements:

> I have assisted a number of researchers in the lab. I have access to the lab results but I have not had access to the reports or findings after completion of research projects. I think that the knowledge produced may have been made available to my superiors or could be confidential. (Lab technician)

> I have not had access to findings after completion of research by researchers. Maybe the findings are made available to the head of the department. (Water quality specialist)

> When researchers are conducting fieldwork, we see the water quality results and hear the response from the individuals' experiences in the community. I have not received any report or summary from the researchers I have worked with. The summary of findings or report could have been given to the people at the head office. (Water quality specialist)

From these excerpts, the experiences of most key informants clearly show that they have access to information about water resources during fieldwork and analysis of data. However, after completion of research they do not have access to the knowledge produced. They assume that researchers make the knowledge available to their superiors in their respective organisations.

A key informant said:

> It is difficult to get access to the knowledge about water resources after completion of research because consent has to be given by the head of the department involved. (Water quality expert)

A water quality expert said that people only participate in research projects if they are certain that they will benefit from it:

> In my experience the attitude that most people have both in organisations and communities towards water research is that they want to benefit from it. If they realise that they will not benefit from the project, they refuse to participate. People also have a fear of participating in water projects because of unpleasant experiences or other reasons best known to them.

Local communities said that knowledge about water resources is not made available to them after completion of research. The knowledge they have about water issues in their communities stems from their own observations and experiences:

> Our water is not safe because sometimes it has a greenish appearance, insects and the taste is not acceptable. I know that the water from the wells is not safe because it may have bacteria since there are many pit latrines in the area. So, I use tap water from the communal taps provided by Kafubu Water and Sewerage Company for drinking and cooking. (Woman, age 65)

One man (age 38) said:

> I use water from the source [spring were the stream starts] for domestic needs. The water is good but we treat the water because it may carry some bacteria as it comes up through the soil structure. Water from the well is not safe because we have seen some insects in the water and it may have bacteria. The crop yield in our community has reduced drastically. I believe this is because the water quality and environment is deteriorating.

Most residents from local communities said that they do not have much information about the quality of their water because it is difficult to know until analysis is done:

> I do not know or do not have any idea about the quality of our water. You people [researchers] come to take samples and leave without coming back to tell us what may be in our water. Since no one returns, I assume that the water quality is good. So, I draw water from my well, but the water is sometimes not safe because we have incidences of diarrhoea. I expect to be informed when there are harmful contaminants in my well after analysis. However, this has never happened. You are the first person to come back to our community with results about samples collected from our water sources in the past. (Woman, age 35)

Residents from local communities experiencing water issues have not had access to results of analyses of water samples collected from their water sources and they do not have access to research findings:

> Receiving water quality results from researchers after completion of research does not happen in this community. In fact, we have never had access to results before. (Man, age 47)

Two women (ages 29 and 33) said the following:

> I have never had a researcher come back and inform me about their findings.
>
> We do not get any type of information after you people [researchers] leave our communities with the information we give you and samples from our water sources. We are not happy about it.

5.2.3 Outside imposition of solutions

Local communities and key informants are not informed about the knowledge produced in research. They are also not involved in deciding which mitigation option or solution will be appropriate for their community, as shown in figure 11.

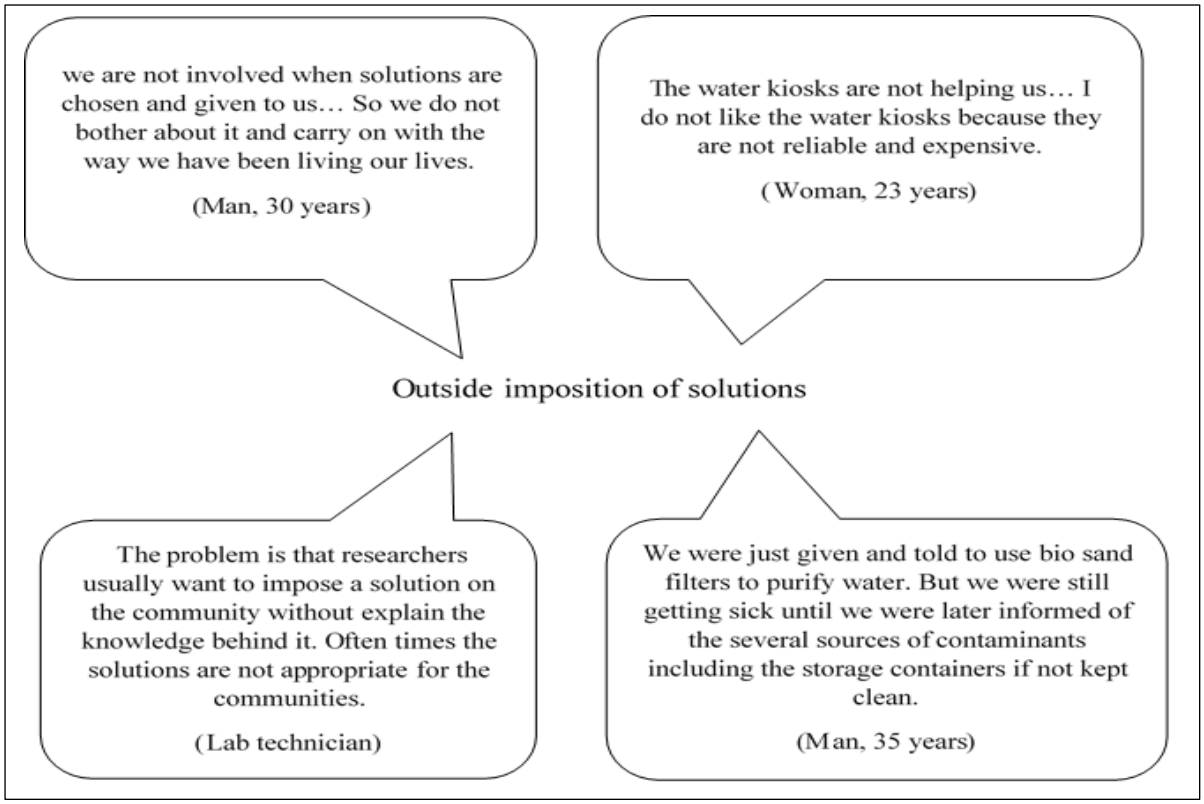

Figure 11: Outside imposition of solutions

Hence, the mitigation options for addressing water issues recommended by researchers face the risk of being rejected by the people. This is because people feel that researchers impose solutions to address the water resource issues being experienced. As a result, most of the recommendations or mitigation options have not achieved the desired result. The lab technician communicated his concern about this issue:

> I have noticed one problem. Researchers come in and try to convince people in communities about an issue without making them understand the idea behind it. If a solution or recommendations is imposed on the community, it is very likely that it will be unsuccessful.

A woman gave an example of the water kiosks as a solution to water issues being faced in their community, saying:

> Most of the times I cannot afford to buy water from the kiosk. The water supply from the kiosk is not reliable at times. When I get back from work in the evening, I am usually very tired to go to the kiosk to get water for drinking and cooking, so I just draw water from my shallow well as it is more convenient and cheaper but may not be safe because we sometimes get sick from consuming the water from the well.

5.2.4 Objects and source of water research data

The local communities feel that researchers have been studying them as objects or subjects who are experiencing water issues. Over the years, several researchers have visited their communities to make observations, conduct questionnaire surveys, and collect samples from their water sources (see figure 12).

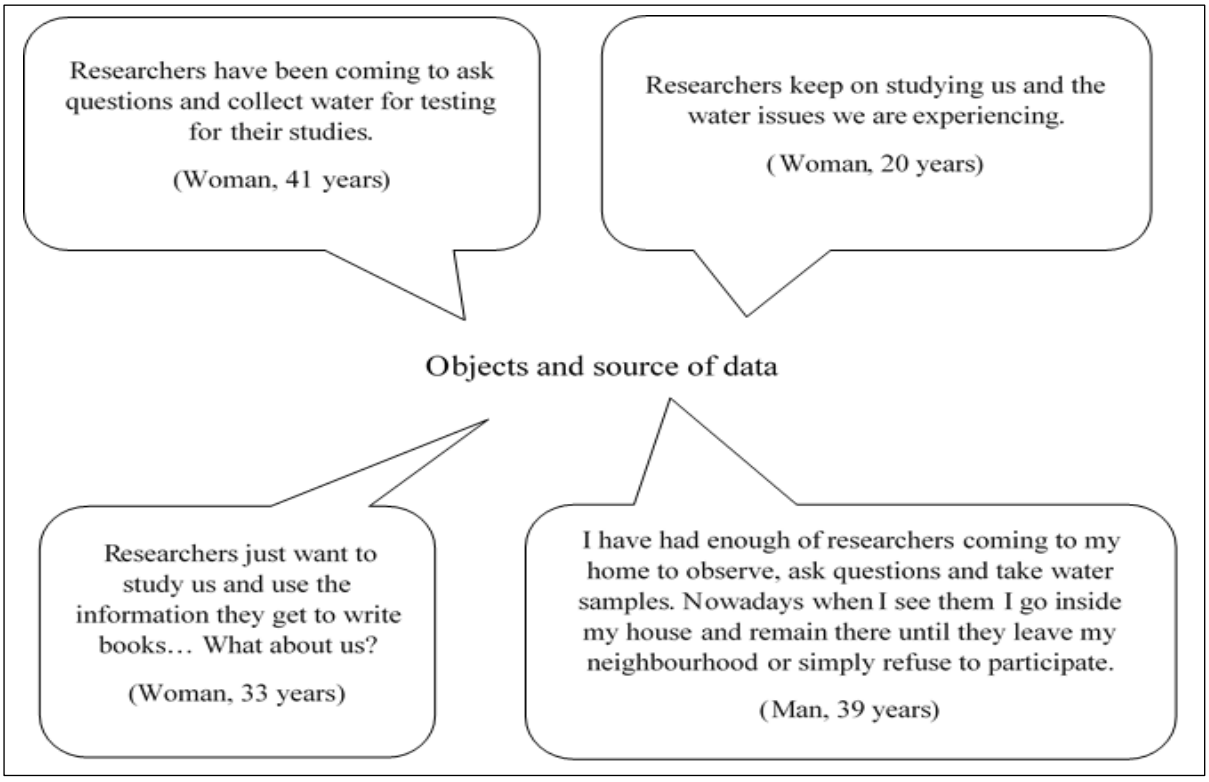

Figure 12: Objects and source of data

This has led to communities wanting to have nothing to do with research and researchers because they feel that they have been disrespected and their households have been infringed upon several times in the name of research.

A 50-year-old woman said:

> What about us? You people [researchers] keep coming to see, ask questions and take water samples for your studies. We have participated in many studies about water issues in our community but this has not helped us at all. I have stopped participating in water research. I do not allow researchers to collect water samples from my well because I am not an object for study [she was very upset]. We too are human and are forced to use these water sources with poor water quality due to circumstances beyond our control. Instead of being respectful and compassionate, you people use our predicament by studying us as objects.

A woman (age 42) tells a story about her experience with researchers:

> One day a researcher came to my house to get information and water samples from my well. I was asked questions about water issues. Then the researcher asked if they could get water samples from my well. I agreed, and during the process the container they were using to collect water fell in the well. The researcher then used another container to collect the water samples. Obviously, it was difficult for the researcher to remove the container so, when they left my house, the container was left in my well. I was not happy about this.

***

Residents from the communities do not want to be involved in research. They are not pleased with the way researchers have been conducting water projects.

We have seen that residents from the participant communities unanimously want water quality results or findings returned to them. But what then, is the best way to do this?

5.3 Water quality communication method preferred by communities

To communicate water quality results to residents from communities in Ndola, I held focus group meetings with individuals from communities that participated in Liddle's water study in Ndola in 2013. I shared water quality results from Liddle's study with participants from Kabushi, Nkwazi, and Kaniki communities. The focus group meetings revealed that individuals from these communities preferred having face-to-face discussion as a method of communicating water quality results.

5.3.1 Water quality results from Liddle's study

Liddle's study revealed that some water sources for domestic needs in Ndola, particularly the rivers, streams, and hand-dug shallow wells, contained contaminants (mainly aluminium, iron, manganese, and faecal coliforms). These contaminants exceeded the recommended maximum values set by the World Health Organisation. This was the case in Kabushi, Nkwazi, and Kaniki communities, where people are forced to use water from hand-dug shallow wells and waterways for domestic needs (see boxes 1.1, 1.2, and 1.3) due to intermittent water supply, lack of money to buy water from water kiosks, and lack of infrastructure for water supply.

5.3.2 Communication method preferred in Kabushi

In Kabushi, the Kafubu River had high concentrations of aluminium, iron, and faecal coliforms. High faecal coliform levels were found in a shallow well. These contaminants were over the maximum acceptable value set by the World Health Organisation (see box 1.1, p. 51). To take back the water quality results to Kabushi, I held focus group meetings, with 15 participants, where the water quality results, major concerns, and mitigation options were made available to participants via the brochure, discussion, video, and presentation methods (Center for Innovation in Research and Teaching, 2016).

Residents of Kabushi said that they preferred having a discussion because they felt that it ensures dialogue, where questions and concerns are raised during the process:

> We are very happy that you have come in person. It is most helpful to come and discuss with us. We are able to freely ask questions, we did not only listen to you but you also listened to what we have to say about our water. We have learnt more and we now have a good understanding of the water issues we are facing.

The other reason residents from Kabushi preferred the discussion method is because it is culturally acceptable. One woman (age 58) said:

> Traditionally we use oral communication, so the discussion method is expected. It is considered respectful to meet face to face to discuss an important topic like water issues and safeguarding people's health.

The brochure, video, and presentation methods were not preferred because these methods do not encourage dialogue. The participants said:

> Reading the brochure and watching the video is not a problem. But we might not understand something or we may have a question that we would like to ask about the water quality issues you are sharing. Most of us do not have the means of communicating back to you via email, phone call or travelling to meet you; as a result we may end up having more questions and concerns than before.

Having a presentation as a method of communicating water quality results is a good idea but was not suitable for the focus group participants, who said:

> Presenting water quality results is a good idea, but it does not encourage dialogue. We only get to contribute or ask questions at the end of the presentation. It is not fair because you speak most of the time but we only get to speak at the end.

5.3.3 Communication method preferred in Nkwazi

In Nkwazi, the stream and a shallow well had high levels of aluminium, iron, manganese, and faecal coliforms (see box 1.2, p. 53). The stream had high levels of aluminium and iron which were over the maximum acceptable value set by the World Health Organisation. The concentration of manganese in the stream was above the United States Environmental Protection Agency's maximum acceptable value. The shallow well had a manganese concentration slightly below. The stream had extremely high levels of faecal coliforms compared to the shallow well. Both the stream and well had faecal coliform concentrations over the maximum acceptable value set by the World Health Organisation. The shallow well had extremely high levels of aluminium and iron which were over the maximum acceptable value set by the World Health Organisation (Liddle, 2014).

I held focus group meetings to take these water quality results, the major concerns, and mitigation options back to individuals who participated in Liddle's study in Nkwazi. I used the brochure, discussion, video, and presentation methods to share the knowledge from Liddle's study. All 10 focus group participants opted for the discussion method. They said:

> It is better to come back again and discuss the results with us. In this way, we learn from each other [researcher and local community] and we both benefit from research about our water.

The focus group participants did not favour the video and presentation methods. The video is an interesting method that can be used to lure people, but when they realise what the video is about they either do not pay attention or leave. This is because they have had enough of being involved in water research where they have not been involved effectively and have not seen any benefits. They said:

> The video can be helpful because it can be used to lure people to be involved in this issue [sharing water quality results]. Some people would rather watch a video about water issues than being told [presentation]. We are sick and tired of being talked at, so we do not even pay attention. Most of us would not pay attention to the video because one just sits and watch. The video encourages less participation [not interactive enough].

The brochure method was not preferred by the focus group participants because they felt that it was similar to the video and presentation methods where information is transferred onto the people without giving them the opportunity to participate in the process. Some participants had challenges with the brochures. It was difficult to read the water quality results, the significant concerns, and the mitigation options because some participants cannot read English or Bemba. They said the following:

> Brochures are not suitable because some of us cannot read English or even Bemba [or their own local language]. The brochure may end up being thrown away as people may think it is not helpful. Some may receive the brochure but feel lazy to read it.

A woman (age 35) from the focus group meeting in Nkwazi said:

> I have other things to do. I have to do housework, go for work and take care of the children when I come back. Reading that paper [brochure] is time consuming. I would rather do other things.

5.3.4 Communication method preferred in Kaniki

The water quality results from Liddle's study in Kaniki revealed that the shallow well had a high concentration of aluminium. The well and stream had high faecal coliforms levels that were over the maximum acceptable value set by the World Heath Organisation (see box 1.3, p. 54). I held a focus group meeting with individuals who participated in Liddle's study in Kaniki. Like with the Kabushi and Nkwazi communities, I used the discussion, presentation, brochure, and video methods to take the water quality results, major concerns, and mitigation options back to participants in Kaniki. The method that was chosen by the 12 participants is the discussion method. They said:

> Having a discussion is the best method for bringing back scientific findings. The most important thing about having a discussion is that we educate each other [local community and researchers]. We now have a good understanding of the likely source of contaminants and which is the safer source of water.

According to the participants in Kaniki, the brochure and video are good but they are not the best methods. The following two excerpts show what the participants thought about the brochure and video:

> We would like to discuss the water issues in detail instead of just reading about it. A video is an interesting way of communicating information but it is not the best because we cannot have the opportunity to discuss and educate each other.

> The individuals who do not have the opportunity to read the brochure or watch the video may not believe us if we tell them. So, visiting us as you have done and discussed the water issues with us is better because we all have heard for ourselves [in person], we have asked questions, shared our understanding of water issues with you and we have also been educated in the process. Thank you so much.

The presentation method was not suitable to participants in Kaniki because it reminds them of the classroom, where the researcher is the teacher and the local community are the students. The participants from Kaniki said:

> You stood in front explaining the water quality results, significant concerns, and mitigation options while we were seated listening. The presentation method reminds us of school. It is very formal and felt like you are in charge and we are here to receive information then ask questions at the end.

5.4 Conclusion

The semi-structured interviews revealed that the residents from Kabushi, Nkwazi, and Kaniki communities in Ndola have had enough of participating in projects about water issues. They have been participating in water research projects over the past several years and have not seen any benefit. They have had enough of being studied as objects or subjects experiencing water issues. Several researchers have visited their communities to make observations, conduct questionnaire surveys, and collect samples from their water sources. After completion of research projects, the researchers do not share information about water resources produced from the research with the key informants and residents from Kabushi, Nkwazi, and Kaniki communities.

From the focus group meetings, I found that individuals from these communities preferred face-to-face discussion as a method of communicating water quality results, significant concerns, and mitigation options to them. Having a discussion is acceptable because oral communication is a traditional way of sharing information and is considered to be respectful. However, the brochure, presentation, and video methods were not considered appropriate. These methods do not allow researchers and local communities to learn from or educate each other. The methods do not encourage dialogue, are not inclusive, and give the researcher control over the local communities as they encourage the transferring or depositing of information from the researcher to the local communities (a top-down approach). Therefore, the chapter that follows is a discussion of the results in this chapter in relation to social justice in research.

6. Social justice in scientific research

6.1 Introduction

This study set out to examine the appropriate methods for returning research findings to communities facing water quality issues in Ndola, Copperbelt Province, Zambia. This is the first study that explores appropriate methods for returning research findings to communities facing water quality issues and describes participants' experiences with water research projects in Zambia. As shown in chapter 5, the experiences of residents from communities that have been participating in research confirm that there is unequal access to scientific knowledge about water quality in Ndola. This inequality has created a strong desire amongst residents to have access to knowledge about water resources, which they are deprived of after completion of research. Often times they are studied as objects experiencing water issues, and mitigation options are imposed on local communities without sharing with them the knowledge behind the options. Hence, these approaches are often less effective and subsequently they fail to safeguard the health of residents of communities with poor water quality issues.

All these concerns and complaints stemming from communities' experiences have led many individuals to refuse to participate in water research projects. They are unhappy with the approaches used by researchers to conduct water research whereby they are denied access to knowledge produced after completion of research. They do not trust researchers because they have realised that they are being exploited as researchers benefit by gaining recognition when they produce knowledge about water issues using information and water samples collected from their communities (at their expense). The experience of residents from participant communities in Ndola gives a basis for describing and revealing inequality in research projects.

With all this in mind, *What method is appropriate for returning water quality results to communities in Ndola, Copperbelt Province, Zambia?* This study has found that face-to-face discussion is the appropriate method for communicating water quality results with participant communities in Zambia after completion of research projects. According to the focus group participants, having a discussion ensures exchange of water resource information and an environment where concerns can be raised, questions asked and clarifications made. They want or expect to have a meeting with the researcher after completion of research to talk over water quality issues because it is culturally acceptable. A discussion enables both local

communities and researchers to benefit from research because they learn from each other and so co-produce knowledge about water resources. Access to knowledge produced from water resource research through face-to-face discussions enable local communities' effective participation in water resource issues. Effective participation allows for mitigation efforts to be directed towards the right issues and is more likely to have maximum impact, such as improved access to clean water and safeguarding the health of local communities.

This chapter explains the results in relation to existing literature about the appropriate methods for sharing research findings with communities after completion of research projects and communities' experience in participating in research projects. Also included are the study's implications or practical applications, and recommendations are given for further research about local communities' effective participation, particularly access to knowledge after completion of research and in water resource management. This chapter concludes with highlights of the key results of the study.

6.2 Appropriate method of sharing knowledge after completion of research

I examined the results in relation to existing literature about Euro-western paradigms and decolonising methodologies in research. The results are consistent with several studies and other findings that show that inequality in research is perpetuated by researchers who often benefit from conducting research at the expense of participant communities. The results show ethical injustice in water research in Ndola in the form of inequality, particularly concerning access to water resource knowledge after completion of research projects.

6.2.1 Face-to-face discussion method in Ndola, Zambia

Firstly, these results apply to Ndola and are relevant to communities throughout Zambia. About 5 million people out of 15 million want access to clean water (Water Aid, 2016) and so to water resource knowledge. The focus group participants preferred face-to-face discussion as the appropriate method for sharing water resource knowledge with them because they belong to tribes where oral communication is one of the traditional methods used to share information. Zambia is a diverse country with 73 tribes where in any one community there are people from a variety of tribes (Taylor, 2006). Most tribes in Zambia have common proverbs that promote respect for the voice in discussions when building knowledge. For example, the Bemba-speaking people have the following proverbs:

- *Ako usulile ekapa amano*: Means the person you are looking down on is the person that can give you great advice. Do not look down on an idea from anyone as it may be the best one in achieving your goal.
- *Umunwe umo, tausala inda*: Means one finger alone cannot pick lice. Issues are solved by working together; even different opinions on certain issues should not drive a wedge in achieving the desired goal.

The voices of the participants in this study were heard by holding face-to-face discussions, where people were able to learn more and gain a better understanding of the water quality issues being experienced. The water resource knowledge discussed with residents from communities with poor water quality can be used to improve access to safe water and protect the health of residents from communities in Ndola. This corresponds with Shortland and Gregory (1991), who state that sharing knowledge produced from research with participant communities is beneficial because they gain a better understanding of the issues they are experiencing and their involvement can be helpful in considering the appropriate option for addressing them.

I found that conducting myself according to the customs of the community when sharing water quality knowledge encouraged the participant communities to speak openly about their experiences with water research and with water quality issues. Adhering to appropriate cultural conduct[6] enabled me to conduct myself in a manner that was not offensive and did not discourage the community members from participating in the focus group meetings.

The participants were very happy that I returned to their communities to share the water quality knowledge gained from Liddle's study. They had the opportunity to engage in a dialogue, enabling them to reflect deeply, ask questions, and talk over concerns and mitigation options. According to the focus group participants, they "want and expect to have face-to-face discussions about an important topic like water issues and safeguarding peoples' health". "Meeting face to face is traditionally appropriate and it is considered respectful to come back and discuss the results because it enables learning from each other". In this way, the researcher and communities can both benefit from research by fully understanding the

[6] I used Bemba a language spoken by most of the focus group participants from the communities. I respected all the participants, especially the elders by kneeling and saying terms that signify respect, and I was dressed appropriately as my body was covered; I wore a chitenge (traditional wrapper worn by women) over my clothing.

water issues being faced, which cannot be achieved by depositing or imposing research knowledge onto the participants in a top-down manner.

Concerns with depositing or imposing research knowledge on to participants

The brochure and video methods are top-down approaches of sharing research knowledge because through these the water quality results, significant concerns, and mitigation options simply were transferred to the participants. They deprived the focus group participants of inquiry because they became passive receivers of the research knowledge. The knowledge from Liddle's study was deposited into them; this process is known as banking education (Freire, 1970). They found it challenging to ask questions after reading the brochure and watching the video. This is because after I leave the community, contacting me after receiving and reading the brochure or watching the video implies time, money, and other related constraints.

Listening to a presentation is another method of depositing research knowledge into the participant community because it does not encourage dialogue and discourages learning from or educating each other. The participant communities received the research knowledge passively and they only got the opportunity at the end to ask questions, raise concerns, make clarifications, and provide more information when needed. According to the individuals from participant communities in Ndola, the brochure, video, and presentation methods do not encourage dialogue because these methods gave me as the researcher more control (put me in charge) while they were only present to receive information then ask questions later. I found that depositing research knowledge indeed does deprive residents of participant communities in Ndola of inquiry and so developing praxis, consequently making it even more challenging for them to come up with their own inventive ideas, options, and designs to improve access to safe water and to safeguard their health. This fits in with Freire (1970), who states that change in affected communities can be achieved through praxis – "theory plus action, reflection" – where communities reflect on information or their condition and act to change their world based on their own values or needs.

However, in Ndola the participants are forced to take up the researchers' values or ideas in water research. Researchers often impose their ideas on communities experiencing water issues. They do not clarify the underlying issues to the communities, denying them the opportunity to extensively discuss the water issues being experienced, and "as a result, recommendations to address water issues or mitigation options are unsuccessful" (Lab technician). According to Shortland and Gregory (1991), this occurs because the

communities are underestimated by researchers, who often find it challenging to explain knowledge produced from research. Researchers often think that communities are not interested and cannot understand the deeper issues about science. I argue that researchers who think and consider communities in this manner are arrogant; similarly, Tuhiwai Smith (2012) argues that it is arrogant to think that communities are not interested in science and will not understand it.

Communities developing critical consciousness

Individuals from communities in Ndola are exploited as a source of data or information by researchers. Inevitably this exploitation of data or information has led to inequality in terms of who reaps the benefits of water research. The information gathered is used to produce knowledge about water resources which is then owned by the researcher, placing them in a position of advantage where they attain another title or more recognition in the research world. The communities that participated in the water research project do not benefit because they do not have access to the knowledge produced, leaving them curious about the findings of the water project they participated in, and also with the same challenges in accessing safe water, hence perpetuating poverty.

Denying people access to knowledge that they helped produce is a form of oppression. I argue that in the case of residents from communities with water issues in Ndola, educational forces in the form of Euro-western research paradigms have been keeping people down as they are based on exclusionary research which reflects dominance over and exploitation of participants, where water resource knowledge produced is marginalised from communities in Ndola. This inequality is maintained by the continued use of these paradigms which are based on the ideas, needs, views, and interests of researchers who often oppress participants while benefiting from the studies. The residents from participant communities have developed a form of "critical consciousness" by realising that they are being oppressed. They have critically examined their situation from experiences with water research projects and demand change in the research methods to take into account their interests, including but not limited to access to research knowledge, rather than uncritically continuing to participate in research where colonial methods are employed.

Residents from participant communities have had enough of being the object of water studies where water samples and interesting information produced can be gained from. They are upset with researchers because while they have participated in many studies about water issues over the past several years, this has not helped them. This inequality has created

conflict between the researchers and communities with water issues in Ndola who feel alienated from the water resource knowledge they have been co-producing with researchers. Therefore, this conflict between the researchers and communities in Ndola is influencing the communities' behaviour in research; they have increasingly become more reluctant to participate in water research. Hence, there is a strong legitimate refusal among the residents in Ndola of anything that is associated with water research – they are "sick and tired of being seen as objects of study" (Woman, 45 years). So, the attitude that most people have both in organisations and communities in Ndola towards water research is that they want to benefit from it, while others have the specific demand of being offered access to the water resource knowledge produced. This means that they understand that while oppression in water research is both historic and present, it is not their destiny as it can be changed.

Therefore, for change to occur and to build and maintain trust which has been broken by colonial research methods, I suggest that the participants need to be in charge and at the centre of every stage of the research project. To be able to achieve this, I received and accepted criticism about inequality in research being practised by researchers from the residents of participant communities in Ndola while assisting Liddle with data collection in 2013. I respected and gained some understanding of their views and concerns with respect to their participation in water research. Therefore, from the beginning of this study I focused on the benefits that the communities will get from the research project; the research problem, objectives, and methods used were developed based on how to better address access to the water resource knowledge they helped produce in 2013 and their effective participation in this study.

Co-production of knowledge and effective participation in water resource research

In Ndola, knowledge about water resources is co-produced by researchers and participants from local communities. Residents from local communities put in efforts by providing the required data or assistance to the researchers. The water samples collected from participants' water sources and the information gathered by researchers via questionnaire surveys, interviews, and focus group meetings are used to produce knowledge about water resources. The knowledge can be used to help communities experiencing water issues in Ndola. The knowledge can either contribute to existing knowledge concerning water resource issues or it can be new knowledge that can be used to understand and address water resource issues in Ndola in particular. Similarly, Chilisa (2011) states that the knowledge produced from research can be used to help participant communities experiencing an issue.

According to Visvanathan (2005), in knowledge production effective participation is part of the broader rights owed to society, together with the right to social justice. Appallingly researchers often dismiss the needs of communities upon completion of research because they are denied or lack access to the knowledge they helped produce (Durose et al., 2011). This is the case in Ndola where the experts and the residents from local communities are denied effective participation in research because after completion of water projects, they are not given access to the knowledge that they put in efforts to co-produce. For example, participants said:

> Researchers from different backgrounds come to our communities to collect data, they learn from us, and we learn other methods from them as we work to produce knowledge about our water resources. But after completion of research projects we do not have access to the knowledge we helped produce.
>
> Researchers come to take samples and leave without coming back to tell us what may be in our water. Since no one returns, I assume that the water quality is good. So, I draw water from my well, but the water is sometimes not safe because we have incidences of diarrhoea.

This confirms the hypothesis that there is unequal access to scientific knowledge about water quality by local communities in Zambia.

Therefore, to improve access to safe water, local communities in Ndola must be engaged in effective participation in water research via research methods which are based on their needs, are respectful, and are beneficial to them. Similarly, Liddle (2014) suggest that water experts engage local communities via community-based participatory planning because this guarantees significant outcomes in water resource management, particularly improving access to safe water. This is because Liddle's study revealed that local communities in Ndola, particularly informal communities, are not engaged in effective participation in water resource issues. Could this be the same in other African countries? I will answer this question in the next section by discussing the experiences of other African communities and the method used to share knowledge produced in research.

6.2.2 Sharing research knowledge in other African communities

The findings of this study fit in well with Bagele Chilisa's notion of Afrocentric methodologies. Chilisa (2011) suggests the use of Afrocentric methodologies for Africans and people of African descent. This is because people throughout Africa want to have rights over their own land, water, and bodies, and they demand respect, that their voices be heard, and that they benefit from research. Afrocentric methodologies can also be used as a guide for research with marginalised groups and Indigenous peoples, particularly those from formerly colonised countries. Afrocentric methodologies are contextually relevant to African communities because they focus on the African experience, perspective, and interpretation of information (Chilisa, 2011). African communities have different cultural and social orientations from those of Euro-western countries as they feature empathic practises driven by compassion and the desire for co-existence (Van Stam, 2013). This is done mainly through communal efforts whereby the traditional method used to share information is oral communication.

Real communication systems in natural settings involve people meeting to engage in dialogue: people share information, ask questions, and complement and corroborate with each other to address issues based on realistic practices (Chilisa, 2011). For example, like the Bemba-speaking people, the Tswana-speaking people of southern Africa have proverbs that promote respect for the voice in dialogues or discussions when building knowledge. Here are some examples (Chilisa, 2011, p. 291):

- *Mmua lebe oa bo a bua la gagwe*: Means everyone has a right to speak for even what might appear like a bad suggestion helps people to think of better ideas.
- *Mafoko a kgotla a mantle otlhe*: Means every voice has value in a gathering.
- *Dilo makwati dikwatololwa mo go babangwe*: Means we learn from others.

Therefore, Chilisa (2011) recommends the presence of the voices of research participants by engaging them in dialogue about their material world. Engaging communities that are culture-oriented in effective participation requires the researcher to follow cultural protocol when conducting research projects, especially if the research is a tool for social change in Indigenous communities (Chilisa, 2011). "All cultural centres are to be respected, and thus, the diversity that is characteristic of Africa is accommodated as the researcher shifts from one cultural space to another" (Chilisa, 2011, p. 185). For example, when I held focus group meetings with residents from the three local communities in Ndola, I respected and adhered to acceptable cultural conduct. I found that this made the individuals feel more comfortable to

participate in the study and helped me avoid behaving in a manner that would have offended them.

According to Chilisa (2011), the approaches that are appropriate when conducting research with Indigenous communities are indigenous methodologies because they do not perpetuate self-centred research methods constructed using Euro-western understanding. However, similar to the findings in Ndola, researchers often use dominant Euro-western research paradigms which reflect their interests in African countries (Chilisa, 2011). They often exploit data and information from participants as they have more economic, political, and social power than the participants. The knowledge produced using the data and information gathered from participants is marginalised from African communities. Inevitably this exploitation of data or information from communities leads to inequality in the benefits of research because the knowledge produced is used as a commodity and is set apart from the community where they got the information or data or that helped produce the knowledge.

Exploitation of data and marginalisation of research knowledge are a common feature of research projects in Africa. An example is the story of how researchers from the South African Council for Scientific and Industrial Research, along with Phytopharm, stole African indigenous knowledge of local resources from the San about the hoodia cactus plant (Chilisa, 2011). As this plant has properties that stave off hunger, these organisations used it to manufacture diet pills which they sold for a lot of money (See section 3.2). Therefore, Chilisa (2011) suggests that researchers must ask themselves several questions before conducting research, such as, *Does the research take a clear stance against marginalisation and exploitation of the participant community?* and *Does the research address power struggles, oppression, and social differences?* In this way, the realities of the participant communities count as they are not left out in producing, legitimising, and benefiting from research knowledge.

According to Robert Chambers (1997), the reality of the community does count, and its members should be put first, not last. Chambers has had experience with several development projects in developing countries, including African ones, focusing on the continuing methodological revolution to empower people to take control of their own destinies. Take research projects: researchers tend to behave as though they are "superior" to the individuals from the communities experiencing an issue and impose their realities, ideas, and solutions ("superior" knowledge) on those communities (Chambers, 2007, 2008), similar to the case of

participant communities in Ndola. Chambers (2014) recommends individuals seek out methods of research that consider people as actors instead of objects of observation and sources of data. Chambers (1997) further calls for personal, professional, and institutional change as it is essential to better recognise the needs of the poor or other people who are the most affected by an issue. Therefore, the researcher must be patient and critically aware of their own self to proactively listen to and learn from the communities and to hand over the research project to them.

To ensure effective participation by local communities, the people and the researchers work together to produce knowledge about issues being faced (Chambers, 2005). Chambers (2007) recommends showing people their reality, which can be done by giving them access to knowledge produced in research about their community via participatory approaches. Development scholars Goldman and Abbot (2004) support the use of participatory approaches because it encourages positive behaviour due to access to scientific knowledge (see the story about cessation of open defecation in section 3.6).

In this section I attempted to highlight Chilisa's, Chambers', and other development scholars' recommendations on conducting research and sharing research knowledge with African communities. I will now discuss sharing research knowledge and the research experiences of Indigenous and colonised peoples.

6.2.3 Sharing research knowledge with Indigenous and colonised peoples

In terms of the world's Indigenous and colonised people, Tuhiwai Smith (2012) argues that in order to decolonise them we need to put Indigenous people at the centre of research planning and design and not just at a later stage. It is also important to follow cultural protocol and to take in the perspective of Indigenous communities when collecting information, data, or samples for use to produce knowledge as it is the backbone to self-determination, which can be used to achieve the desired change in Indigenous communities. For example, in New Zealand, Kaupapa Māori (see section 3.6) is an approach where culturally appropriate methodologies and protocols are used in research with Māori (Tuhiwai Smith, 2012). The ethical codes of conduct for research with Māori are based on the proverbs such as (Tuhiwai Smith, 2012, p. 124):

- Aroha ki te tāngata (respect others)
- Kanohi kitea (the seen face; that is, present yourself to people face to face)
- Titiro, whakarongo… kōrero (look, listen… speak)

- Manaaki ki te tāngata (share and host people, be generous)
- Kia tūpato (be cautious)
- Kaua e māhaki (do not flaunt your knowledge)
- Kaua e takahia te mana o te tāngata (do not trample over the mana of the people)

In this way, the place of everyone and everything in the universe is respected, and through respect, balance and harmony are maintained. Therefore, when Kaupapa Māori is followed, the place of people from Māori communities is respected; they are not studied as objects of research (like the story of the Roma people in Spain who were seen as objects of study, section 3.2) and ideas or solutions are not imposed on them. Information or data from them is not exploited and they have access to the knowledge produced after completion of research projects via face-to-face communication. This is because face-to-face communication is part of Kaupapa Māori; the Māori proverb "Kanohi kitea" requires one to present oneself to people face to face.

Not only is face-to-face discussion culturally appropriate for sharing knowledge after completion of research, it also enables dialogue as community members get access to research knowledge and are given the opportunity to reflect deeply, talk over their challenges, and express their views and feelings about an issue (Tuhiwai Smith, 2012). Therefore, face-to-face discussion ensures that research knowledge reaches community members who participated in the research. Consequently, trust is developed between the researcher and participant communities because they are engaged at every stage, right to the final stage, particularly sharing the knowledge produced from research, as it leads to a deeper understanding of the challenges being experienced (McDavitt et al., 2016). For example, in the Canterbury region of New Zealand, the Canterbury Water Management Strategy is a collaborative framework that was developed based on extensive consultations with local communities, including the major Iwi (tribe) of the region, Ngāi Tahu, in order to develop a sustainable approach to addressing Canterbury's water issues (see Chapter 1).

The misrepresentation and exploitation of indigenous knowledge and lack of respect for Indigenous people and their cultures has raised a lot of debate on who should undertake research with Indigenous people. For example, there has been an increase in demands on the part of Indigenous communities for research with Indigenous people to be undertaken exclusively by Indigenous researchers (Tuhiwai Smith, 2012). I believe that this could be because of the thought that an Indigenous researcher conducting research with their

community will feel morally responsible and conduct themselves in a manner that is culturally acceptable, as well as being able to give a more realistic account of their communities, who then will benefit from research. However, in my experience,[7] I have observed that both local (Indigenous) and international (non-Indigenous) researchers have been using methods which are based on Euro-western paradigms that reflect the Euro-western way of knowing, perpetuate the domination and exploitation of research participants, and marginalise them from the knowledge produced in research.

Therefore, I suggest that there is need to fund and train more researchers (both Indigenous and non-Indigenous) in decolonising methodologies. This is because it is vital for researchers who are planning to conduct research with Indigenous people to fully comprehend what decolonising methodologies involve and thus guarantee participant communities self-determination and the most useful outcomes that will benefit them. This ensures that Indigenous communities take greater control over issues they want to address in culturally appropriate, safe, ethical, and useful ways and so build more knowledge about their communities. The knowledge, if required, empowers them to take the right actions to improve their society, while building or maintaining a relationship between them and researchers based on mutual respect and trust.

However, the decolonising framework will not always fit for non-Indigenous researchers, for those who do not have time and are not trained in indigenous methodologies. Hence, I suggest the use of Freire's framework when considering conducting research with people and sharing research knowledge with participants. This is because Freire (1974) argues that it is dehumanising to not consider the perceptions, needs, and desires of people. To prevent further dehumanisation, he suggests and stresses the importance of having counter-hegemonic approaches to knowledge production. In this way, true knowledge emerges from critical inquiry via effective involvement of people in an issue (Freire, 1970).

Like the case in Ndola, the oppressed communities have developed a deep understanding – a "critical consciousness" – of their reality by realising that although inequality in research occurs in their communities, it is historic and real, it is not their future because it can be altered. Hence, they are asking or demanding for access to water resource knowledge. Similarly, Indigenous peoples have demanded a shift away from oppressive non-beneficial Euro-western methods in research. They have been calling for research approaches that allow

[7] Working as a research assistant for both local and international researchers in Zambia.

for their effective participation and is based on their values, respectful of their culture, people-centred, and people-led. By participating effectively and benefiting from research, individuals can be transformed through praxis – "theory plus action, and reflection" – where they reflect and act to change their communities and people based on their values.

Take the sharing of knowledge with people: researchers use several different methods in an attempt to share research knowledge. Knowledge can be transferred or deposited into participant communities, like the banking concept in education (Freire, 1970). Freire is against this concept because it is a top-down model for sharing research knowledge where the flow of knowledge is from the researcher to the participant community (the receivers). The researcher is seen as all-knowing, more privileged, and the most important; they deposit research knowledge into the participant community rather than having a dialogue with the affected community because they often relate to research knowledge as something to gain and own. For these and other reasons, knowledge is considered and used in the same way as other commodities and is set apart from the community (Allman & Wallis, 1997). In other cases, a community may receive knowledge as a gift from the researchers who consider themselves knowledgeable and the community without understanding (Allman & Wallis, 1997; Freire, 1974). Based on Freire's framework, I agree with Allman and Wallis and argue that considering knowledge produced from research as a commodity and denying participants access to knowledge that they helped produce is oppression, and approaches that encourage this perpetuate inequality in research. Therefore, it is vital that researchers critically consider the ethical issues that may arise when conducting research about issues that concern people.

6.2.4 Ethical codes of conduct in research with people

According to Edwards and Mauthner (2012), ethics involve the morality of human conduct; in social research in particular, ethics refers to the researchers' moral reflection, decisions, and accountability in all stages of the research process. Therefore, in response to general concern from people globally, there has been rapid development regarding ethics in social research (Edwards & Mauthne, 2012). In contemporary qualitative research, the four main tendencies that operate are empiricism, instrumentalism, postmodernism, and ethicism.

In relation to ethicism, Hammersley (cited in Edwards & Mauthner, 2012, p. 16) recommends that researchers have

> a tendency to see research almost entirely in ethical terms, as if its aim were to achieve goals or to exemplify ethical ideals… Whereas previously ethical

considerations were believed to set boundaries to what researchers could do in pursuit of knowledge, now ethical considerations are treated by some as constituting the very rationale of research. For example, its task becomes the promotion of social justice.

According to Banks and Scheyvens (2014), undertaking research in a developing country can present a lot of ethical issues, such as unequal power gradients, exploitation of participants, and the one-sided generation and ownership of knowledge. To enable researchers to adhere to ethical principles throughout the research process, Banks and Scheyvens (2014) suggests that they should seriously consider the ethical issues which may arise in all stages of research if they want to conduct fieldwork in the developing world. This is because it is morally right for them to be considerate of the needs and rights of research participants and it enables them to conduct themselves in manner that is sensitive and respectable. Equally, Dowling (2016) further states that research that does not contribute to self-determination and the benefit of others is colonial research. Therefore, she suggests the use of decolonising research because it is based on open, democratic, and equal relationships, where the rights, perspectives, knowledge, desires, needs, and concerns of people are valued.

People have concerns about their interests not being reflected in research; for example, ownership of knowledge produced in research is among the main concerns of research participants (Marshall & Batten, 2004). To address this ethical concern, Darou, Hum and Kurtness (1993) suggest sharing or giving the participants access to the knowledge and hence its ownership. Access to research findings allows for discussion of their meaning and application to empower participant communities (Dowling, 2016). This requires and reminds researchers of their ethical responsibility to share research knowledge after completion of a project. I found that sharing research knowledge with participant communities is the ethical responsibility of researchers, a point that is also advocated by several scholars including Chilisa (2011) and Tuhiwai Smith (2012) who argue that it is among the fundamental features of decolonising methodologies.

According to Fernandez et al. (2003), participants' access to knowledge produced in research is an area that until recently was surprisingly neglected by many researchers. Most literature centres on improved research methods, particularly individuals' effective participation and ethical considerations. Sharing knowledge produced from research with the participant community and engaging them throughout the communication process is a fundamental feature of effective participation (McDavitt et al., 2016). To attain effective participation,

sharing knowledge about research findings involves having a two-way dialogue between the local community and researcher. Up to now there have been few examples in the literature that explain how to engage participant communities in dialogue regarding research findings, particularly with communities that have experienced oppression and marginalisation. Consequently, such communities mistrust researchers due to past or present social injustices encouraged and maintained through colonial methodologies which are socially designed, culture-specific, and extremely affected by the western world (Van Stam, 2013).

For example, the typical methods used by researchers to share knowledge with academic audiences and professional stakeholders include providing a copy of the report, writing a journal article, thesis, or book, and giving a presentation in scientific form, which the community members find too technical (Sommer, 1999). For other stakeholders, particularly the general public and those with low academic literacy, scientific writing is inaccessible because it is often not appealing, usually long, and difficult for them to understand. Hence, the implications for practice may not be clear to them. To help them understand scientific knowledge and its related implications for their communities, the knowledge is transformed from the research context to the societal setting.

Miller (1986) suggests communicating with the general public using a practical, people centred, non-technical, simple, and pictorial method. The knowledge can be shared with the community via social media, a community newsletter (information sheet or brochure), a community presentation, and a video (Center for Innovation in Research and Teaching, 2016). I suggest sharing research knowledge after completion of research with participants via community meetings, where the findings, implications, and mitigation options can be discussed with participant communities face to face. This ensures co-production of knowledge about a subject matter because the participant communities are given an opportunity to be involved effectively and if needed are empowered to address the issue.

According to Durose et al. (2011), co-production of knowledge has been recently considered as a possible solution to the problem of research methods that fail to effectively involve communities in research. Co-production of knowledge has been identified as the solution to bridge the gap between communities and researchers. It is significant because it ensures that principles of empowerment are put into practice (Durose et al., 2011). The researcher works with communities to co-produce knowledge by giving them more control over the research process and providing them with an opportunity to learn from and reflect on their experience.

In this way, relevant issues or questions that may otherwise be neglected by researchers or experts are identified and highlighted (Fischer, 2000; Collins & Evans, 2002). According to Ostrom (1996, p. 1), "co-production implies that citizens can play an active role in producing public goods and services of consequence to them" and argues that co-production is relevant to the study of synergy and development. For example, in research, effectiveness is enhanced because it is better informed by the needs and preferences of the community which is actively involved in the process, ensuring attainable solutions and improved outcomes (Ostrom, 1996).

However, as discussed earlier there are hidden power dynamics in the research process, where the needs of communities are often dismissed and discouraged by unequal power relations (Durose et al., 2011). For example, returning research findings is often not considered and done by researchers as it is common practice not to go back and ensure that research knowledge be made accessible to the communities that participated in the research. In most cases researchers consider writing their thesis or journal article as the final stage of their study; they do not consider sharing their findings with the communities that helped produce the knowledge. I argue that it is highly unethical to not share findings with participants, especially if the research project's timeline schedule and budget includes gathering data or information from people. I suggest that it is fair to go beyond mere consideration and provide for taking back knowledge produced with participants when designing the research project's schedule and budget. In addition, this is an expected part of the Human Ethics Committee process, where the participants have the right to demand access to findings after completion of research projects and to refuse to participate in research that affects them if they are not interested. Consequently, researchers have an ethical responsibility to get proper consent from people and to respect their rights.

Jung, Harrow and Pharoah (2012) conducted several different studies where co-production of knowledge in research occurred and they acknowledge that co-production of knowledge is among the most effective ways to guarantee the desired research impact. In my opinion, this shows that the interest or needs of the participant community is often not the focus of research, rather it is the research impact, particularly production of knowledge. Still, they have highlighted that co-production of knowledge is being done mainly among practitioners, policy-makers, and researchers (experts). Consequently, the voices of affected people are absent or dismissed in decision-making, and the ethical and political justice of those decisions therefore results in undermined and weak outcomes (Young, 2011).

To get rid of unjust research methods, I argue that researchers must do away with colonial approaches if both the researchers and participant communities are to benefit via effective participation, mutual respect, collective production, and access to and ownership of the knowledge produced in research projects. Similarly, several scholars (Chambers, 2014; Chilisa, 2011; Liamputtong, 2010; Tuhiwai Smith, 2012; Swadener & Mutua, 2008) also suggest doing away with research approaches based on unequal structures to conduct research. They call for research methods that allow for effective participation, where equal structures are used and based on indigenous values. For example, Chilisa (2011) and Tuhiwai Smith (2012) argue that inequality can be done away with by using decolonising methods that allow for effective participation, equal power structures, mutual respect, co-production, and access to and ownership of knowledge produced from research.

6.3 Application of study results, further research and water resource management in Zambia

This study has highlighted the importance of, and need for, scientists to share research findings with participants. If people's lives or health may be affected by an issue, such as problems with their water or food source, then sharing research findings should be an ethical must when conducting research. Researchers who want to conduct research with people and issues that concern people should include in the research schedule and budget the taking back or sharing of knowledge produced with the participants themselves. This is because time and funding must be allocated and is required for this to occur. For scientists who go through the ethics procedure in their institution, where they are required to share the transcripts and research findings with the participants, it is vital that they go a step further to fully explain how they will achieve this, while bearing in mind that certain communication methods may be inappropriate for particular audiences.

After careful consideration and explanation of how the research findings will be shared with participants in the human ethics application, the institutions involved must put in place additional procedures that ensure that the researcher fulfil their ethical responsibility of sharing research findings after completion of research with the participants who requested it. For institutions or departments where research is conducted without ethical consideration of the participants, particularly studies about natural science that involve issues that affect people, it is imperative that they put in place an ethical procedure which must be adhered to in order to protect the rights of the participants, including providing access to knowledge produced from research.

The findings of this study are specific to residents from Kabushi, Nkwazi, and Kaniki communities in Ndola, Copperbelt Province, Zambia, where local communities have a unique background and cultural orientation and a number of development issues. Further studies are required to establish the appropriate method of taking back research knowledge to participant communities in other parts of the world. More research in this area is necessary both in developing and developed countries, where people have different backgrounds, cultures, and social orientations. This is because different locations have different specifics (social context); community members may prefer the brochure, video, presentation, or some other method over the face-to-face discussion method preferred by the participant communities in Ndola. However, it is possible that similar findings will be obtained because most individuals or participants would rather have a discussion (dialogue) via a community meeting or focus group to share knowledge produced from research. This is evident from the preferences of African, Indigenous, and colonised peoples' communities, as discussed earlier in this chapter.

In developing countries like Zambia, drinking contaminated water is the main human health threat (Water Aid, 2016). To safeguard the health of citizens lacking access to safe water, improving water resource management and treatment of water is essential. Furthermore, several recommendations have been suggested by local and foreign researchers to address the water resource challenges being faced in Zambia (World Bank, 2009; Republic of Zambia & Federal Republic of Germany, 2007; Liddle, 2014). In addition to these recommendations, there exist several policy documents in Zambia that provide principles for managing water resources. These recommendations and policies are often based on or informed by scientific knowledge produced from research projects.

Recommendations and policies regarding water resource management have not helped the condition of affected communities in Zambia because about five million people still lack access to safe water (Water Aid, 2016). The scientific knowledge behind these recommendations and policies is not made available to individuals in local communities who are thus denied the opportunity to access scientific findings. Therefore, I recommend sharing knowledge produced from water research projects with participant communities because this enables the effective participation of local communities, co-production of water resource knowledge, and communities ownership of that knowledge. In this way, mitigation efforts will be directed towards the right issues, such as improving access to safe water in Ndola. In this way, maximum impact can be achieved in Zambia to contribute towards attainment of the Sustainable Development Goals.

6.4 Conclusion

Inequality in research is encouraged and maintained through Euro-western paradigms, which Chilisa (2011) and Swadener and Mutua (2008) identify as colonial research methods because they reflect the interests of researchers who are considered to have more economic, political, and social power. This study revealed that inequality in research is practised by researchers in Ndola, who often benefit from producing water resource knowledge at the expense of participant communities. This is because colonial methods are being used by researchers who have been exploiting water samples and information (data) from communities to produce water resource knowledge. The knowledge produced is marginalised from the participant communities as they do not have access to the knowledge they helped produce. Researchers also study communities as objects or subjects experiencing water issues and impose their ideas or solutions on them. This is ethically unjust because participant communities deserve respect and access to the knowledge they helped produce by engaging in and putting effort into research. Therefore, as Tuhiwai Smith (2012) argues, it is the responsibility of researchers to share water resource knowledge after completion of research with participant communities.

One of the appropriate approaches that can be used to share research findings with participant communities is decolonising methodologies. Decolonising methodologies ensure that knowledge produced from research is shared and they also feature methods that are respectful and beneficial so as to achieve self-determination for Indigenous communities. Face-to-face discussion was preferred by individuals from participant communities as it is a culturally appropriate method and is best for everyone who is not a scientist. Friere's framework is another method that can be used to ensure individuals participate effectively and reflect on their condition and so take the required actions.

Overall, I urge and remind researchers considering undertaking research with people to conduct themselves in a manner that is morally right and to employ research methods that are embedded in social justice. This is because it is morally right to consider the needs, perspectives, concerns, safety, and rights of research participants as it ensures that the research participants are respected and ethically involved throughout the research process. To avoid using methods that promote and perpetuate inequality, I suggest the need for ethical reflection or probity and procedures regarding the methods to be used, and training for scientists considering undertaking research about an issue that concerns people, such as domestic water source.

7. Conclusion

For future research and current practice, I suggest that researchers ought to carefully consider all the ethical issues that may arise when considering research into issues that affect people, so as to go a step further to ensure the safety of participants and protection of their rights. It is not just about filling out the human ethics application which researchers may consider as a task to tick or cross off the list when done or a requirement to conduct research with people. Some may consider critical thinking about their conduct and social justice in research as a limitation because they may not be allowed to conduct research if the safety of research participants is threatened and their rights are not respected. Others may consider it as time-consuming and may not adhere to the ethical procedure and conduct themselves in a manner that is morally wrong. Ethics is about the moral reflection, choices, and accountability of the researcher throughout the research process (Edwards & Mauthner, 2012). Ethics consistute the very rationale of social research as it promotes social justice (Edwards & Mauthner, 2012).

Researchers have the ethical responsibility of sharing knowledge with participants and people who are affected by the issue being researched because it is their right and because they are the ones most affected by the issues being experienced and so investigated. It is the basic right of participant communities to be able to access to research knowledge as it enables effective participation of local communities who gain a deeper understanding of the issues being experienced and are empowered to come up with their own innovative options to mitigate the issues in a manner that is locally appropriate (Chambers, 1997; McDavitt et al., 2016). Furthermore, it is also important to note that there are some culturally specific ethical considerations when conducting research with Indigenous and formerly colonised peoples. These ethical considerations are framed in cultural terms and are based on the needs, perspectives, and values of the community involved and are for its benefit. The aim should be to respect and protect the rights, interests, and feelings of the people and to ensure their safety (Chilisa, 2011; Tuhiwai Smith, 2012).

I now return to the five objectives of this study. Firstly, I read through Liddle's thesis in order to gain a sound understanding of her research findings, which I used to develop the video, brochure, presentation, and discussion methods of sharing water resource knowledge with the participant communities. The other key documents I read include Zambian government reports and policies, as well as reports from non-governmental organisations and universities about water resources, so as to give a detailed account of water resource information. I also

reviewed the scholarly literature to gain an in-depth understanding of the theories that explain inequality in research and the various approaches used by researchers when they conduct research with people.

Secondly, I visited key informants at their workplaces as well as individuals' homes in Kabushi, Nkwazi, and Kaniki communities to conduct semi-structured interviews. I conducted the semi-structured interviews to gain an understanding of the experiences of residents with water research projects in communities experiencing water issues in Ndola, Copperbelt Province, Zambia. The results have shown that water research projects are conducted with residents from local communities in a manner that deprives them of effective participation. Researchers consider them as subjects or objects experiencing water issues and use them solely as a source of data through which to produce water resource knowledge.

Researchers benefit by producing water resource knowledge and gaining recognition in the academic world at the expense of residents from communities experiencing water issues. The water resource knowledge that the participant communities help to produce is not shared back with them. At times the researchers impose their ideas and recommendations on the local communities without sharing the underlying issues behind the knowledge that would enable them to better understand the water issues being experienced. Lack of access to water resource knowledge after completion of research has angered many residents from communities experiencing water issues and has created mistrust between local communities and researchers. As a result, the majority of residents from these communities are now reluctant to participate in water research projects, hence confirming the hypothesis that there is unequal access to scientific knowledge about water quality by local communities in Zambia.

Thirdly, to answer the research question, *What method is appropriate for returning water quality results to communities in Ndola, Copperbelt Province, Zambia?* I conducted three group meetings with individuals from Kabushi, Nkwazi, and Kaniki communities, where I explored using the video, brochure, presentation, and discussion methods to take back to the communities water quality results, significant concerns, and mitigation options emerging from Liddle's study. All the participants preferred face-to-face discussion as the appropriate method of sharing water resource knowledge with them after completion of research projects. The face-to-face discussion method is culturally acceptable since the majority of the participants belong to tribes where oral communication is widely used. Face-to-face

discussion ensures dialogue, whereby community members are able to reflect deeply, talk about challenges, and express their views about poor water quality. Sharing research knowledge via face-to-face discussion was essential as it ensured that the water resource knowledge reached residents from participant communities and so helped to develop trust between the communities and me.

The majority of the participants from the three communities decided to share the water resource knowledge with their neighbours and other community members who were not present. The following is a story of what happened after the residents from the participant communities had obtained access to the water quality results, significant concerns, and mitigation options from Liddle's study.

One woman (69 years), who was born and still lives in Kabushi Township, expected the water quality results from the Kafubu River to be poor because some people throw different types of garbage and contaminants in the river while others use it to wash clothes and do other water-related chores. She knows that the numerous pit latrines in the high-density area are a potential threat to their groundwater, so she understands the bacterial risks involved in the use of water from the shallow wells. Even if the water quality results from Liddle's study showed that the shallow wells are relatively safe compared to the Kafubu River, she still said that she will not use water from those wells for drinking and cooking because they are prone to bacterial contamination from the latrines. She will continue to use water from the communal taps and boreholes because they are dug deeper into the soil profile and are protected from contaminants.

Another woman (35 years), from the Nkwazi area, said that she will no longer risk her health and that of her family by drawing water from the stream or the shallow well since the water quality results from Liddle's study revealed that both sources contained high levels of contaminants that could affect their health. She said that she will make sure to draw water from wells that are dug deeper into the soil profile and then boil the water before use because she cannot afford to buy chlorine or water from the water kiosks for daily use.

A man (40 years) and woman (25 years) from the Kaniki area said that the water from the spring-fed stream will continue to be their source of water for domestic needs because when the water is drawn upstream (at the spring source) it is expected to not have contaminants. But since the water quality results from the water sample drawn downstream by Liddle revealed high levels of faecal coliforms, they will use biosand filters. Those that do not have

the filters said that they will boil their water before drinking because they cannot tell by appearance or smell if the water has contaminants. They said that they will not use the shallow well to draw water for domestic use as it is exposed to faecal coliforms from the pit latrines and contaminants such as aluminium in surrounding area.

The man said that he would have really appreciated if the water sample had beendrawn upstream or at the source of the spring to know the quality of their domestic water source. In fact, the man was very proud of their spring-fed water source, saying that when the water comes up through the soil profile it is relatively pure compared to the recycled water that people drink in the city. He strongly argued that the recycled water is not purified or treated enough for human consumption. This led to another discussion about the process of water purification and the commercial water utilities ensuring that the levels set by the Zambia Bureau of Standards are met. Still, he said that he does not trust water utility companies because it is possible that the water treatment may not be effective or up to the standards due to some challenges that they may face and as a result may put peoples' health at risk.

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Fourthly, I recommend use of decolonising methodologies and Freire's framework when developing principles for sharing research findings with participant communities. Using principles from these approaches, I have contributed to knowledge about the appropriate method (face-to-face discussion) that can be used to successfully share water research knowledge with communities in Zambia. However, concerning communities from other countries with different specifics, where people have a different background, social orientation, culture, and development status, further research is required to explore appropriate methods of sharing research knowledge with participants. The findings from other countries will be significant to allow a better understanding of the approaches that researchers can use to ensure that their research findings reach the participant communities.

Finally, the fifth and final objective was to make recommendations on how to better address water resource management in Zambia. To improve access to safe water in Ndola the water resource experts and researchers must ensure that they share water resource knowledge with communities experiencing water issues. Access to water resource knowledge is necessary to bridge the gap between the local communities and the experts and to enable the establishment of trust. In this way, mitigation efforts will be directed towards protecting water sources, practising or improving water hygiene, and the use of alternative safe sources of water. I

recommend the same for other communities to improve the condition of those five million people who lack access to safe water in Zambia (Water Aid, 2016). This will enable effective participation of local communities in water resource issues and will empower community members to improve their access to safe drinking water. Improving access to safe drinking water is a significant step in attaining the UN's Sustainable Development Goals because a reliable source of safe water is one of the basic human needs which is necessary for the elimination of poverty, the improvement of people's health, and other development-related changes (Harp, 2010).

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Appendices

Appendix A: Human Ethics Committee – Student Application

Project Title: Exploring appropriate approaches to returning water quality data to communities in Ndola, Copperbelt Province, Zambia.

Status of Research: **Masters**

Applicant

Name: **Mando Chitondo**

University Programme/ Department: **Waterways Centre for Freshwater Management**

Applicant's Email: **mando.chitondo@pg.canterbury.ac.nz**

Primary Telephone No: **0221902692**

Primary Supervisor

Name: **Dr Kelly Dombroski**

University Programme/ Department: **Geography**

Supervisor's Email: **kelly.dombroski@canterbury.ac.nz**

Primary Telephone No: **64 3 3642987 xt 7936**

Other Supervisors

Name: **Julie Clarke**

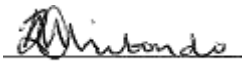
University Programme/ Department: **Waterways Centre for Freshwater Management**

Supervisor's Email: **julie.clarke@canterbury.ac.nz**

Primary Telephone No: **64 3 364 2987 xt 7937**

Researcher's Signature

I *Mando Chitondo* have considered, the various ethical issues involved in this research, I have discussed this proposal with my supervisor(s), and I will conduct this research within the bounds of any approval given by the Human Ethics Committee of the University of Canterbury.

Signed:  Dated: 28TH March 2017

Is the approval of this application a necessary pre-requisite for the Dean of Postgraduate Studies to formally accept your Masters proposal? **YES**

Senior Supervisor's Signature

As the primary supervisor of *[insert applicant's name]* research project I, *[insert Supervisor's name]* consider that the design and documentation are of a standard appropriate for a research project carried out in the name of the University of Canterbury.

Signed: __ _____ Dated: 28TH March 2017

Low Risk processes (to be completed by the primary supervisor)

Description of the Project

1. What does the project seek to do?

   Many scientific projects carried out in developing countries take data from communities and fail to return any summary of results to the community. Even when reports are written, they are rarely communicated effectively at the community level, especially in low-income areas. This project seeks to understand participants' experience with water research projects and to explore the efficacy of approaches for returning water quality results from Liddle's study carried out 2013 (in which I acted as research assistant) to affected communities in Ndola, Copperbelt Province, Zambia. Results from this project will be presented back to community members in different ways, and seek to establish with research participants their preference for results communication. Because this study will be based on participants' experiences, the project will be beneficial in establishing appropriate approaches for communicating water quality results in Zambia and more widely in African contexts. Overall, the project will contribute to the attainment of the UN's Sustainable Development Goal No. 6, which focuses on ensuring access to clean water and sanitation for all in the next 15 years.

2. What is the research question or hypothesis of this project?

   How can data (i.e. water quality results) be appropriately brought back to the community after research completion?

3. Describe how this project arose

   This project arose due to the issues being faced in the Copperbelt Province with regards to access to water in communities in my home country of Zambia. In 2013, I assisted a Master's student from the University of Otago in her project titled "Assessing the state of the water quality, the challenges to provision, and the associated water development considerations in Ndola, Copperbelt Province". Through this experience, I learnt a lot about the water issues faced in the Copperbelt Province. In addition, many participants were interested in knowing the results from the research we conducted, as they are keen on being involved in finding means to best solve the issues being faced. I realised that the affected communities do not have access to water results as scientific reports and summaries are too technical, often not appealing and difficult to understand. As a result, the affected community (i.e. the stakeholder that is most at risk) is deprived of effective participation in water issues. This creates some degree of mistrust and little involvement and support from communities towards researchers as they feel that they are used only as a source of data since further involvement regarding access to research findings does not occur.

4. How will you go about answering the research question?

   To answer the research question, I will develop a number of data communication options, using data from relevant authorities, publications and the original work by Liddle (2013). I will then conduct semi-structured interviews targeting key informants and focus groups in the affected communities.

Information about the Participants

5. Who are the participants and why have they been chosen to be asked to participate?

   Participants in this study include key informants and individuals from communities in Ndola. These participants have been chosen because they were involved in the project carried out by Liddle and me in 2013.

6. How many participants will be involved (of each category where relevant)?

   Semi-structured interviews will be with water providers in Ndola; these include local authorities, non-governmental organisations and the water utility company.

Five to six people from each institution will be interviewed. Three focus groups will be carried out with five to ten participants from local communities with poor water quality; these include Kabushi, Kaniki and Nkwazi communities.

7. Selection criteria and/or exclusion criteria will you use?

The community participants selected in this study for focus groups are individuals from communities who were involved in the project carried out in by Liddle and me in 2013. Willingness to take part in the project by individuals will determine who will take part or who will be excluded. If they come to the focus group meetings they will be included.

If the recruitment phase is not successful, then I will have to conduct one-on-one interviews in public spaces or private homes. I will also interview people I know from the previous project, as well as the leaders from the targeted community groups.

8. Describe how potential participants will be identified and recruited?

Potential participants will be identified when I visit communities that participated in the 2013 project. Participants in the focus groups will be recruited through the leaders of the targeted community groups. This is because researchers are expected to contact the community leaders who will then assist in setting up meetings with the community members; these include political, cultural and religious leaders. In Zambian context, it is culturally acceptable and expected to access participants via networking. This is because Zambian communities have a cultural and social orientation which features empathic practises driven by compassion and the desire to co-exist. The key informants will be from institutions that are involved in provision of water and they will be recruited by visiting their work places.

9. Does the project involve recruitment through advertising? **NO.**

10. How much time are participants asked to contribute to the research?

The semi-structured interviews will take 30 minutes to one hour. This is to ensure that the participant has enough time to reflect and express themselves thoroughly.

Focus groups will take two hours to allow for communicating water quality results using different methods and for the participants to choose which method they prefer.

11. Is any form of inducement to be offered? **NO, but they will get a variety of data communication materials including brochures, watching a video, having a presentation and holding a discussion about research findings.**

12. How will the participants be treated?

    Participants will be treated with respect throughout the focus groups and key informants' interviews. The collected data will be kept private unless otherwise discussed in focus groups. I understand that the individuals or participants have other commitments; therefore, I will ensure that I stick to the indicated time.

13. Will forms for participants need to be translated? **YES, oral consent forms and information scripts for low-literacy participants will be translated into Bemba from English.**

14. Will the project require engagement and consultation with iwi Māori? **NO.**

OTHER PARTIES WITH AN INTEREST IN THE RESEARCH

15. Does the project require permission of an organisation, other people, to access participants or information? **YES. A letter will be written to seek permission to access the required information and participants from organisations which provide water in Ndola; these are organisations who were involved in the original project that Liddle and I collected data for.**

16. Will the project require community consultation? **YES. Prior to beginning of the semi-structured interviews and focus groups, I will share ideas about the project with the organisation leaders, community leaders and community members.**

17. Is the project funded externally? **YES**, **Ministry of Foreign Affairs and Trade. Scholarship for research under New Zealand Aid.**

18. Is the project commissioned by or carried out on behalf of an external organisation(s)? **NO.**

19. Is the project to be part of the CEISMIC digital archive? **NO.**

Data collection

20. Does the project involve a questionnaire? **NO.**

21. Does the project involve a structured or semi-structured interview? **YES.**

    The project involves a semi-structured interview with institutions that provide water in Ndola. The specific questions to be covered include:

    - Describe your experience in the research you participated in in 2013.

    - [Prompt] What kind of information did you get out of the research participation experience?

    - Tell me about a time when you participated in other studies concerning water issues.

    - What do you know about your water?

    - How do you know this?

22. Does the project involve an unstructured interview? **NO.**

23. Does the project involve focus groups? **YES.**

    The project involves focus groups which will be held in three different low-income communities in Ndola. These are Kabushi, Kaniki and Nkwazi communities. Prior to starting the focus groups the participants will be given an oral summary of the project, what is required and expected of them and benefits of taking part in the project. Then they will be asked if they accept or decline to participate in the focus groups. Individuals who choose to participate will be asked to sign the consent forms for the focus groups to commence. For individuals who choose to decline to participate in the focus groups, their choice will be respected and they will be allowed to leave without being criticised.

    The focus group will involve communication of water quality results or findings from the project conducted by Liddle and myself in 2013 using different approaches; these approaches include a presentation, discussion, brochure and

video. The participants will then choose their preference for water quality results communication.

24. Does the project involve recording of Audio, Video or Images? **YES.**

    Audio recordings of semi-structured interviews will be conducted to allow for transcription of data for analysis and discussion of results.

    Video of focus groups activities will be taken for recording and use in analysis and discussion of results. This will be discussed before the focus groups begin, and when people are invited. Individuals can opt out of participation if they feel uncomfortable. The video will be taken and used if participants give their consent and will only be accessed by me, my Research Assistants and my Supervisors. Images of focus groups activities will also be taken for recording and use in discussion of results. The images will only be taken and used if participants give their consent. It is common practise in participatory methods to use video and images to record the activities as the participants create the knowledge and analyse it themselves. This too will be discussed before the focus groups begin, and when people are invited. Individuals can also opt out of participation if they feel uncomfortable. Participants can review digital photos and ask for photos to be deleted if unhappy. The images will be used in the thesis to illustrate the different approaches used to communicate data to participants from targeted communities. Images will also be used for presentation of results back to the communities after completion of the project.

25. Will participants be given the opportunity to check the transcript and/or notes of their interview/focus group? **YES.**

    The participants will be given the opportunity to check notes of their interview or their participation in the focus group meetings to ensure that the researcher has captured their experience which will be described or discussed in the thesis.

Informed and Voluntary Consent

26. By whom and how will information be given to potential participants?

    For high-literacy participants (key informants) the procedure for consent will involve the following:

Initial contact is made with the possible participant who is given a short written summary of what the project is about. Then the participant will be informed as to the types of questions that would be asked or what is required or expected as well as the benefits of taking part in the project. At this point, the participant will have the chance to either accept or decline without judgement.

Secondly an information sheet and a consent form will be provided for the participant which outlines the project's aim, background information, methods that will be used, the required data and benefit from participating. At this stage the consent form will give the participant another chance to withdraw/pull out without judgement.

Thirdly after the participant has shown that they want to take part in the research, they will sign the consent form which will be handed back for the researcher to continue with collection of data from the participant.

For low-literacy participants (from low-income communities) an outline of the project will be explained, and then interest in taking part will be implied in turning up to the focus group. Before the focus group begins, I will read out the oral consent script and note consent from people in the group. If some individuals do not consent, they will have an opportunity to discuss their concerns and pull out without judgement. If any semi-structured interviews take place with low-literacy participants, the oral script will be discussed and consent recorded using a voice recorder or a note will be made in a book.

27. Are all participants competent to give consent on their own behalf? **YES.**

    This is because all the participants that are targeted in this project are adults (over 18 years).

Privacy and Confidentiality

28. Will information pertaining to or about the participants be obtained from any source other than the participant? **YES. Water quality results (in electronic file) from the project conducted in 2013 were obtained from Elizabeth Liddle, who gave consent to use the data in this project. The water quality results are needed as they will be**

communicated to the communities that participated in the previous project. Since I was Liddle's research assistant I know the individuals and communities that participated in the project in 2013, so I will conduct the project directly with the targeted organisations and communities.

29. Is information that identifies participants to be given to any person outside the research team, or if identification of or attribution of comments by participants is sought, please explain how and why. **NO.**

30. Please explain how confidentiality of the participants' identities will be maintained in the treatment and use of the data.

    Confidentiality of the participants' identities does not apply to focus groups as participants will know each other's identities via the focus group meetings and what will be discussed will be heard by every participant. However, participants will not be personally identifiable outside the focus group in the research. To maintain identities of participants from institutions (key informants), participants will be given a code on the consent form and the assigned code will be used when analysing the data.

31. Is an institution (eg, school, business, etc) to which participants belong to be named or be able to be identified in the publication or presentation of this project? **YES.**

    Participants from institutions will be asked if they would like their institution to be identified in the publication or presentation of this project. If the participants choose to be anonymous, then their name or institution will not be mentioned in the document.

32. Where will the project be conducted?

    The focus groups and key informants' semi-structured interviews will be conducted in public spaces. I will conduct the project with two research assistants and I will inform my supervisors and my family members about the location (i.e. where,

when) and what time I am expected to finish as well as inform them when I have finished the fieldwork.

Risk

33. Is there any risk to physical well-being? **NO.**

34. Could participation involve mental stress or emotional distress? **NO.**

35. Is there a possibility of causing moral or cultural offence, inadvertently or otherwise? **NO.**

36. Is deception involved at any stage of the project? **NO.**

37. If yes, please describe the deception, justify its use and attach the debriefing sheet or script that you will use to debrief each participant after they have participated in the project or at the end of the project itself. Please ensure that the debriefing sheet includes an explicit reminder that the participant can withdraw without penalty given the deception involved. The use in the information sheet or consent form or questionnaire of a title that differs from the project title given in this application form, in order not to reveal the real aim of the project, is considered to be a form of deception however mild.

DATA STORAGE AND FUTURE USE

38. Please provide details of how the data will be securely stored, and how you will separate identifying and non-identifying data.

    The data will be stored on the university desktop under the university server P drive. The data will be accessed through my UC username and password. Hard-copy data will be stored in a locked cabinet in the Geography Department where my office is located. During fieldwork, the data will be stored on my personal laptop which can only be accessed by a password, while hard-copy data will be secured in a lockable cabinet in my house. The data will be saved under the university P drive which is backed up daily to avoid losing of data in case of theft of laptop while in the field. In addition, the data will be kept in an encrypted folder on my laptop under a zip archive.

39. Who, apart from the researcher and their supervisor (where applicable) will have authorised access to the data?

Only my supervisors and I will have authority to access the data.

40. What will happen to the raw data at the end of the project?

    After completion of the project, the data will be destroyed after 10 years as I have plans to use the data in the future.

41. What plans do you have for the publication of the data?

    When the research is completed, the institutions with key informant participants will be offered a summary of the results. The Master's thesis document will become public document through the University of Canterbury library database. I also have future plans of publishing the results in a journal.

42. Please describe plans for future use of the data beyond those already described above.

    I plan to use the data as a pilot study for future research as I may use parts of the data if relevant to guide my PhD research. However, data used for the Master's thesis will not be resubmitted for a PhD, of course.

Appendix B: Information Sheet

College of Science

Waterways Centre for Freshwater Management

Telephone: +64 *3 364 2330*

Email: mando.chitondo@pg.canterbury.ac.nz

Exploring appropriate approaches to returning water quality data to communities in Ndola, Copperbelt Province, Zambia.

My name is Mando Chitondo. I am a postgraduate student within the Waterways Centre for Freshwater Management at the University of Canterbury. My research involves exploring of appropriate approaches to returning water quality data to communities in Ndola, Copperbelt Province, Zambia. Residents in Ndola have been experiencing water issues including water shortages and lack of access to safe water for domestic use. I have been living in the Copperbelt Province my whole life and I have experienced these issues, particularly water shortages. As a result, I understand the issues and challenges being faced by individuals in the communities with regards to access to water for domestic use. I also understand that the affected communities are keen on having these issues solved, and hence this project is important to me.

Many scientific projects carried out in developing countries take data from communities and fail to return any summary of results to the community. Even when reports are written, they are rarely communicated effectively. This project seeks to understand participants' experiences with water research projects and to explore the effectiveness of approaches for returning water quality results from Elizabeth Liddle's study in 2013 (in which I acted as research assistant) to affected communities in Ndola. Results from the project in 2013 will be presented back to community members in different ways, so as to establish the research participants' preference for results communication based on their experiences. The project will be beneficial in establishing appropriate approaches for communicating water quality results in Zambia and more widely in African contexts. Overall, the project will contribute to the attainment of the UN's Sustainable Development Goal No. 6 which focuses on ensuring access to clean water and sanitation for all in the next 15 years. You have been asked to participate in this research because you are situated in the area or community that participated in Liddle's study in 2013.

If you choose to take part in this study, your involvement in this project will be to participate in the following:

- A semi-structured interview about your experience regarding participation in Liddle's research. About 30 minutes to one hour will be required for the interviews.

Participation is voluntary and you have the right to withdraw at any stage without penalty. If you decide to withdraw, before the data is analysed, I will remove information relating to you. However, once analysis of data begins, it will become increasingly difficult to remove the influence of your data on the results. To maintain your identity a code will be given on the consent form and the assigned code will be used when analysing the data. The results of the project may be published, but you are assured of complete confidentiality of data gathered in this investigation; your identity will not be made public because instead of names codes will be used. In addition, only my supervisors and I will have access to the data, which will be securely stored in my personal laptop with password and lockable cabinet in a secure office. After completion of this project, the data will be stored for 10 years before it is destroyed. The final document (thesis) will become a public document which will be available through the University of Canterbury Library.

Please indicate to the researcher on the consent form if you would like to receive a copy of the summary of results of the project. This project is being carried out as a requirement of my Master's in Water Resource Management thesis under the supervision of Dr Kelly Dombroski, who can be contacted at kelly.dombroski@canterbury.ac.nz. She will be pleased to discuss any concerns you may have about participation in the project. The project has been reviewed and approved by the University of Canterbury Human Ethics Committee, and participants should address any complaints to The Chair, Human Ethics Committee, University of Canterbury, Private Bag 4800, Christchurch, New Zealand (human-ethics@canterbury.ac.nz).

If you agree to participate in the study, you are asked to please complete the consent form attached to this information sheet and give it the researcher. I appreciate your taking time to participate in this project. Please do not hesitate to contact me on the above details if you have any further questions regarding this project.

Kind regards,

Mando Chitondo.

Appendix C: Oral Information Script

College of Science

Waterways Centre for Freshwater Management

Telephone: +64 *3 364 2330*

Email: mando.chitondo@pg.canterbury.ac.nz

Exploring appropriate approaches to returning water quality data to communities in Ndola, Copperbelt Province, Zambia.

Oral information script for focus groups

My name is Mando Chitondo. I am a postgraduate student within the Waterways Centre for Freshwater Management at the University of Canterbury in New Zealand. Most of you may remember me from the project conducted in 2013 by Elizabeth Liddle and I about water quality and quantity issues being experienced in this community. I have also experienced these issues, specifically water shortages, as I have been living in the Copperbelt Province my whole life.

As a result, I understand the issues and challenges you are facing regarding access to water for domestic use. From the previous project in 2013, I realised that you were interested in the results and complained that researchers carry out projects in developing countries where they take data from communities and do not return results.

Therefore, this project is important because it involves exploring appropriate approaches to returning water quality results to affected communities like yours. Results from the project in 2013 will be presented back to you in different ways to establish your preference for results communication based on your experiences. This project will help establish suitable approaches for communicating water quality results in Zambia and in Africa at large. Overall, the project will contribute to the attainment of the UN's Sustainable Development Goal No. 6, which concentrates on ensuring access to clean water and sanitation for all in the next 15 years.

You have been asked to participate in this research because you live in the community that participated in Liddle's study in 2013. If you choose to take part in this study, your involvement in this project will be to participate in the following:

- A focus group meeting where research findings will be provided to you using a brochure, presentation, video, and discussion to allow for discussion of your preferred approach in communicating water quality results from Liddle's project.

The focus groups will take two hours to allow for communication of water quality results using the different approaches mentioned above, and based on your experience, your preference in terms of results communication. Participation is voluntary and you have the right to pull out at any stage without consequences. If you decide to pull out before the data is analysed, I will remove information relating to you. However, once analysis of data begins, it will become more difficult to remove the influence of your data on the results.

The focus group participants will know each other's identities via the focus group meetings and what will be discussed is not strictly confidential because the participants will hear each other's views. However, participants will not be personally identifiable outside the focus group in the research. In addition, only my supervisors and I will have access to the data which will be securely stored in my personal laptop with password and lockable cabinet in a secure office. The results of this project may be published, but be assured that your identity will not be made public without your prior consent. After completion of this project, the data will be stored for 10 years before it is destroyed. The final document (thesis) will become a public document which will be available through the University of Canterbury Library.

This project is being carried out as a requirement of my Master's in Water Resource Management thesis under the supervision of Dr Kelly Dombroski, who can be contacted at kelly.dombroski@canterbury.ac.nz. She will be pleased to discuss any concerns you may have about participation in the project.

The project has been reviewed and approved by the University of Canterbury Human Ethics Committee. If you have any complaints, you can contact The Chair, Human Ethics Committee, University of Canterbury, Private Bag 4800, Christchurch, New Zealand (human-ethics@canterbury.ac.nz).

Once this project is complete I will visit your community again to present the preferred approach of results communication.

If you agree to participate in the project, please answer the questions on the oral consent form as a record of your understanding and agreement to participate in the project. I appreciate

your taking time to participate in this project. Please do not hesitate to contact me or my supervisor on the above details if you have any further questions regarding this project.

Thank you,

Mando Chitondo.

Appendix D: Consent Form

College of Science
Waterways Centre for Freshwater Management
Telephone: +64 *3 364 2330*
Email: mando.chitondo@pg.canterbury.ac.nz

Exploring appropriate approaches to returning water quality data to communities in Ndola, Copperbelt Province, Zambia.

I have been given a full explanation of this project and have had the opportunity to ask questions. [Yes] [No]

I understand what is required of me if I agree to take part in the research. [Yes] [No]

I understand that participation is voluntary and I may withdraw at any time without penalty. Withdrawal of participation will also include the withdrawal of any information I have provided should this remain practically achievable. [Yes] [No]

I understand that any information or opinions I provide will be kept confidential by the researcher and published or reported results will not lead to identification of participants. [Yes] [No]

I understand that a thesis is a public document and will be available through the UC Library. [Yes] [No]

I understand that all data collected for the study will be kept in a secure office and in a password-protected electronic form and will be destroyed after 10 years. [Yes] [No]

Do you understand that codes will be used to protect the information provided and your identity? However, if you wish to have your name used in the final document, then your identity will be made public? [Yes] [No]

I understand the risks associated with taking part and how they will be managed. [Yes] [No]

I understand that I will receive a report on the findings of the study as the researcher will provide it at the conclusion of the project. [Yes] [No]

I understand that I can contact the researcher, Mando Chitondo, at mando.chitondo@pg.canterbury.ac.nz or her supervisor, Dr Kelly Dombroski, at kelly.dombroski@canterbury.ac.nz for further information. If I have any complaints, I can

contact the Chair of the University of Canterbury Human Ethics Committee, Private Bag 4800, Christchurch, New Zealand (human-ethics@canterbury.ac.nz). By signing below, I agree to participate in this research project.

Signature: _____ Date: _____

Appendix E: Oral Consent Script

College of Science

Waterways Centre for Freshwater Management

Telephone: +64 *3 364 2330*

Email: **www.waterways.ac.nz**

Exploring appropriate approaches to returning water quality data to communities in Ndola, Copperbelt Province, Zambia.

Oral consent script for low-literacy participants

Can you please confirm that you have been given an explanation about the project and have had the opportunity to ask questions? If yes, do you understand the following?

-What is required if you take part in the research, that participation is voluntary and that you may withdraw at any time without penalty.

-That withdrawal from participation includes the withdrawal of any information you have provided should this remain practically achievable.

-That any information or opinions you provide will be kept confidential outside the focus group meetings as you will not be personally identifiable and published or reported results will not identify the participants.

-That all data collected for the study will be kept in secure facilities with a password and will be destroyed after 10 years.

-That any information or opinions will be analysed and discussed in a thesis. A thesis is a public document and will be available through the UC Library.

-That you will have a presentation of the findings of the study as the researcher will provide it at the conclusion of the project.

-That you can contact the researcher, Mando Chitondo, at mando.chitondo@pg.canterbury.ac.nz or telephone: +64 3 364 2330, or her supervisor, Dr Kelly Dombroski, at kelly.dombroski@canterbury.ac.nz for further information. If you have any complaints, you can contact the Chair of the University of Canterbury Human Ethics Committee, Private Bag 4800, Christchurch, New Zealand (human-ethics@canterbury.ac.nz).

Finally, do you agree to participate in this research project? [Yes] [No]

Date: _____

Appendix F: Research Assistant Confidentiality Agreement

Research Assistant Confidentiality Agreement

Exploring appropriate approaches to returning water quality data to communities in Ndola, Copperbelt Province, Zambia.

This research is being undertaken by Mando Chitondo within the Department of Geography, University of Canterbury. The purpose of the research is to examine appropriate methods for bringing data back from a water quality project carried out by Liddle in Ndola in 2013 in communities facing water issues in Ndola.

As a research assistant of this research, I understand that I will be witnessing and hearing recordings of confidential semi-structured interviews and focus groups. The information on these recordings will be revealed by participants who will agree to participate in this research on the condition that their interviews or focus groups would remain strictly confidential. I understand that I have a responsibility to honour this confidentially agreement.

I agree not to share any information on these recordings, about any party, with anyone except the Researcher of this project. Any violation of this and the terms detailed below would constitute a serious breach of ethical standards and I confirm that I will adhere to the agreement in full.

I, _____ agree to:

1. Keep all the research information shared with me confidential by not discussing or sharing the content of the semi-structured interviews and focus groups in any form or format (e.g. WAV files, recordings, videos, photos, transcripts) with anyone other than the Researcher.
2. Keep all research information in any form or format (e.g. WAV files, recordings, videos, photos, transcripts) secure while it is in my possession.
3. Return all research information in any form or format (e.g. WAV files, recordings, videos, photos, transcripts) to the Researcher when I have completed my task as a research assistant.
4. After consulting with the Researcher, erase or destroy all research information in any form or format regarding this research project that is not returnable to the Researcher (e.g. all information regarding research data stored on my computer hard drive).

Research Assistant:

_____	_____	_____
(Print name)	(Signature)	(Date)

Researcher:

_____	_____	_____
(Print name)	(Signature)	(Date)

This project has been reviewed and approved by the University of Canterbury Human Ethics Committee, Private Bag 4800, Christchurch, New Zealand ; email: human-ethics@canterbury.ac.nz

Appendix G: Brochures for Kabushi, Nkwazi and Kaniki Communities

Ukuwamishiwa kwamenshi yakunwa na yakubomfya kufilimwa

Utushishi utusangwa muli ayamenshi kuti twafwa panuma yakwipika amenshi nangu ukubikamo umuti wa chlorine elyo tamulanwa nangu uku-bomfya.

Utushishi kutitwachingiliwa ukwingi-la mufishima nga chakuti mulesuga ifishima ifyabusaka no ukuku-pikwapo.

Ifisabwa nafyo pamopene ne misalu fifwile ukusanfiwa bwino mumenshi yabusaka elyo ta mulalya pamopene na umwakusungila amenshi.

Ukuchingililako iflimwa mumabala pakuti file kula bwino, kutichawama mulepupamo lime pakuchefyanyako utumputawisha twa ulubwe mumush-ili.

Inchende yaku Kabushi

Kabushi ninchende mu Ndola, umwikala abantu ukufika kuli 12,094. Amenshi ya kunwa yantu ba bomfya yantu bemba mufishima ifipi ne ifitali, mukamana elyo na ku ma pompi mumayanda.

Ifyafumine mukupimwa kwamenshi

Ifyafumine mukupimwa kwa ayamenshi fyakuti amenshi mukamana ka Kafubu yalisankane na utunputawishya twa ulubwe (aluminium na iron) na utushishi. Elyo amenshi ya mu chishima ichipi yalisankane na utushishi ichishasuminishiwa kunpendwa ya lubwe na utushishi ukusangwa mumenshi ya kunwa ichipimo cintu akabungwe ka World Health ka pima.

Ukwinga fuma uku koweshiwa kwamenshi

Ulubwe lwapangwafye nalesa umwine talwinga pangwa namuntu iyo.

Lusangwa mumenshi icho lusendwa na mulamba wanfula uyo uuya mukuponesha mufishima elyo na mu milonga ya menshi.

Elyo ututwine utumputawisha utwalubwe (aluminium na iron) abantu balanwina kumo mumenshi. Ifyo ifinga leta ubwafya kubumi bwamuntu.. Limo tekunya fye mumenshi lelo nokupemafye ululwine ulukungu lwa ulubwe nangu utumputawisha twa ulubwe ukwikata kunkanda yamuntu.. Utushishi tufuma mumala ya muntu nangu inama iya kwata umulopa uwakaba. Utu utushishi tusendwa ukupitila mumafisho (amafi).

Ifingafuma mukubomfya amenshi ayakwete utunputawishya twa ulubwe na utushishi

Nga chakuti utunputawishya twa ulubwe (aluminium) twa nwika panshitantali, kuti chaleta ubwafya kubumi bwa muntu. Kuti cha onaula bongo bongo ya muntu, ichilafi, ukunaka, ulukanko, ukuonaula amabo, nfyo na ameno, elyo nefilonda mumala. Utumputawisha twa ulubwe (iron) kuti ya onaula amenso na amenshi ukukana umfwika bwino mukanwa pakunwa.

Kabili utumputawisha twa ulubwe (aluminium) ngatwaikala mumushili kuti twa lenga ifilimwa ukukana kula bwino icho imishila ilafilwa ukutinta amenshi ne ifilyo. Impendwa ya utumputawisha twa ulubwe (iron) nga yachila iyifwaikwa ukusangwa mumushili kuti yalenga ifilimwa uku chinja imimonekele.

Kabili ututwine tushishi nga twasangwa mumenshi yakunwa kuti twaleta ubulwele bwa ku polomia no ukuluka na hepatitis A. Elyo utushishi tulalenga umwela ukuchepa kabili na amenshi mufishima na imilonga ukulanunka.

Ukwinga sangwa amenshi ayasuma

Ifishima ifya fika pa libwe lya panshi sana na amenshi ya ku pompi yali kwata amenshi ayasuma pantu yalichingiliwa kuli utumputawisa twalubwe. (aluminium na iron) na utushishi. Elyo akamana ka Kabushi na ifishima ifpi

Ukupokololako abantu kuli ubu ubusanso amenshi yafwile yafuma mwilibwe lya-panshi sana ilyachishima nangu ku tuntemba twa menshi (kiosk) ukuchila mufishima ifipi ne imilonga pantu mulengila ifyaku-kowesha amenshi elyo bala posaposa mo ubusali.

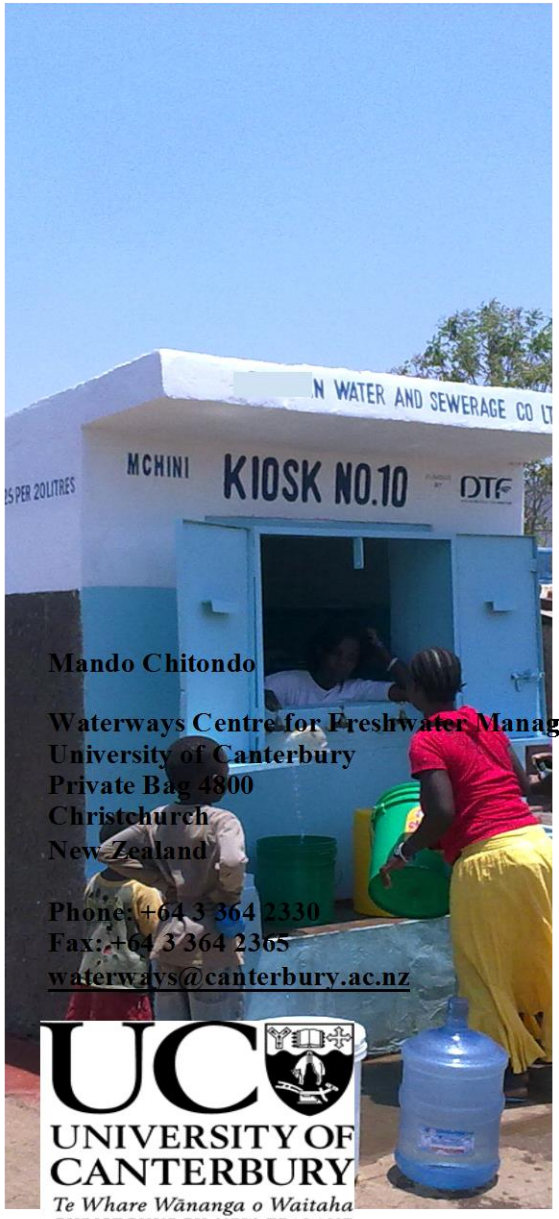
Ukuwamishiwa kwamenshi yakunwa na yakubomfya kufilimwa

Utushishi utusangwa muli ayamenshi kuti twafwa panuma yakwipika amenshi nangu ukubikamo umuti wa chlorine el-yo tamulanwa nangu ukubomfya.

Utushishi kutitwachingiliwa ukwingila mufishima nga chakuti mulesuga ifishi-ma ifyabusaka no ukukupikwapo.

Ifisabwa nafyo pamopene ne misalu fifwile ukusanfiwa bwino mumenshi yabusaka elyo ta mulalya pamopene na umwakusungila amenshi.

Ukuchingililako iflimwa mumabala pakuti file kula bwino, kutichawama mu-lepupamo lime pakuchefyanyako



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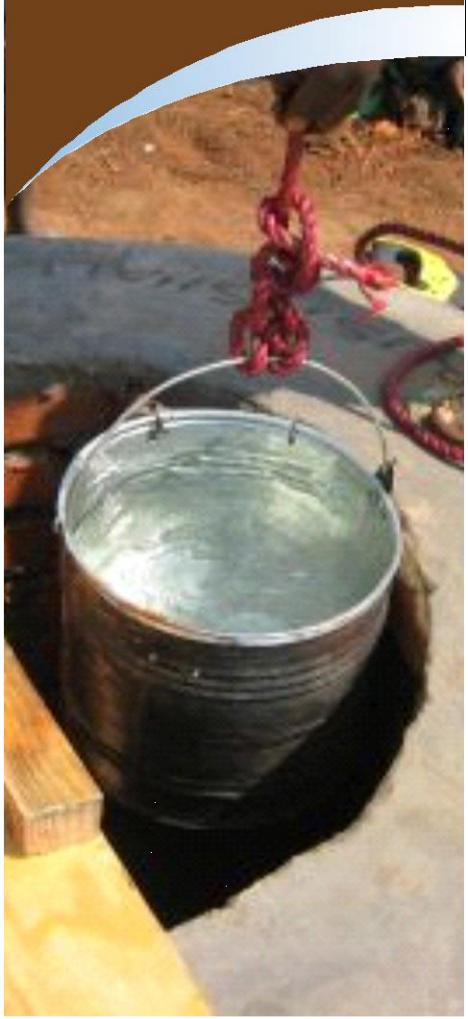
Ukufyaya inshila iya ku bwesheshamo umubela wa menshi panuma yakupimwa



Inchende yaku Nkwazi

Nkwazi ninchende mu Ndola, umwikala abantu ukufika kuli 21,402. Amenshi ya kunwa yantu ba bomfya yantu bemba mufishima ifipi, mukantemba (kiosk) elyo na mumilonga.

Ifyafumine mukupimwa kwamenshi

Ifyafumine mukupimwa kwa ayamenshi fyakuti Muchishima ichipi amenshi yasankane na utunputawishya twa ulubwe (aluminium na iron). Na utushishi. Elyo amenshi ya mu Mulonga yalisankane na utunputawishya twa ulubwe (manganese) na utushishi ichishasuminishiwa kunpendwa ya lubwe na utushishi ukusangwa mumenshi ya kunwa ichipimo cintu akabungwe ka World Health na aka chingilila pesonde aka ku America twa pima.

Ukwinga fuma uku koweshiwa kwamenshi

Ulubwe lwapangwafye nalesa umwine talwinga pangwa namuntu iyo. Lusangwa mumenshi icho lusendwa na mulamba wanfula Elyo ututwine utumputawisha utwalubwe (aluminium, iron na manganese) abantu balanwina kumo mumenshi. Ifyo ifinga leta ubwafya kubumi bwamuntu.. Limo tekunya fye mumenshi lelo nokupemafye ululwine ulukungu lwa ulubwe nangu utumputawisha twa ulubwe ukwikata kunkanda yamuntu.. Utushishi tufuma mumala ya muntu nangu inama iya kwata umulopa uwakaba. Utushishi tusendwa ukupitila mumafisho (amafi).

Ifingafuma mukubomfya amenshi ayakwete utunputawishya twa ulubwe na utushishi

Nga chakuti utunputawishya twa ulubwe (aluminium) twa nwika panshitantali, kuti chaleta ubwafya kubumi bwa muntu. Kuti cha onaula bongo bongo ya muntu, ichilafi, ukunaka, ulukanko, ukuonaula amabo, nfyo na ameno, elyo nefilonda mumala. Utumputawisha twa ulubwe (manganese) kuti ya onaula ubongo bwa umuntu, uku kowesha ifya munganda na amenshi ukukana umfwika bwino mukanwa. Elyo iron kuti ya onaula amenso na ukukana umfwika bwino mukanwa. Kabili utumputawisha twa ulubwe (aluminium) ngatwaikala mumushili kuti twa lenga ifilimwa ukukana kula bwino icho imishila ilafilwa ukutinta amenshi ne ifilyo. Impendwa ya utumputawisha twa ulubwe (manganese na iron) na yachila iyifwaikwa ukusangwa mumushili kuti yalenga ifilimwa uku chinja colour na amabula ukuma.

Kabili ututwine tushishi nga twasangwa mumenshi yakunwa kuti twaleta ubulwele bwa ku polomia no ukuluka na hepatitis A. Elyo utushishi tulalenga umwela ukuchepa kabili na amenshi mufishima na imilonga ukulanunka.

Ukwinga sangwa amenshi ayasuma

Mukutampilapofye imulonga pamopene na ichishima ichipi mwalisangwa utumputawisa twalubwe. (aluminium na iron). Elyo imumulonga mwalisangwa utumputawisa twalubwe (manganese) na utushishi ukuchila inpendwa iyifwaikwa ukusangwa mumenshi ya kunwa.

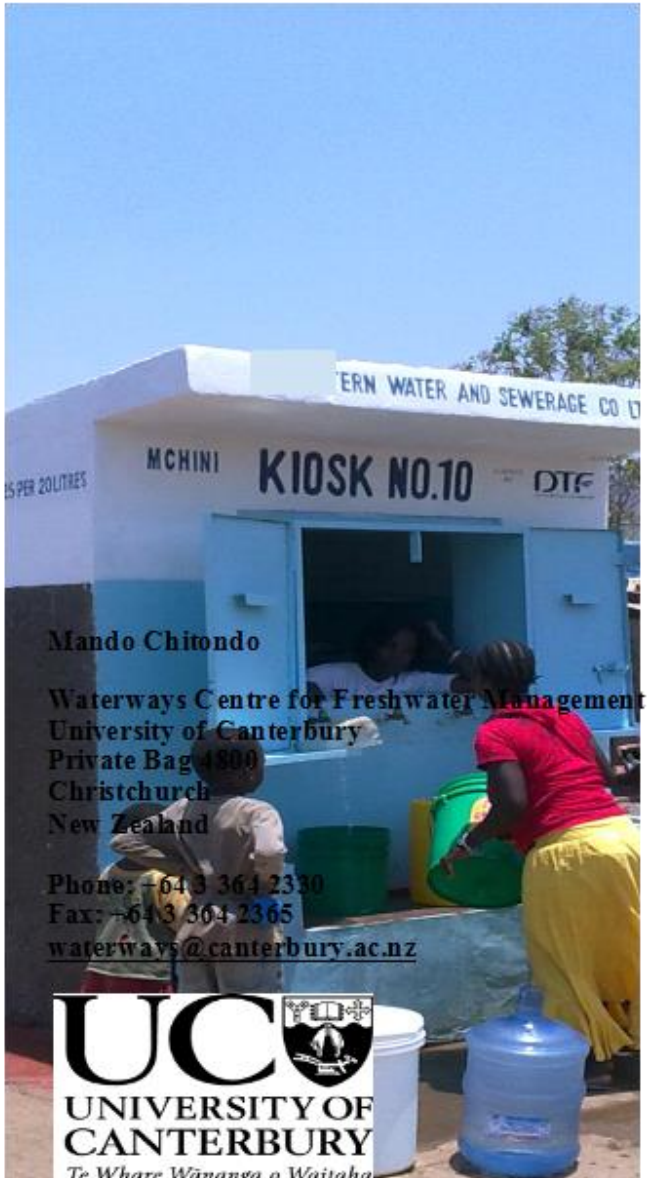
Ukuwamishiwa kwamenshi yakunwa na yakubomfya kufilimwa

Utushishi utusangwa muli ayamenshi kuti twafwa panuma yakwipika amenshi nangu ukubikamo umuti wa chlorine elyo tamulanwa nangu ukubomfya.

Utushishi kutitwachingiliwa ukwingila mufishima nga chakuti mulesuga ifishima ifyabusaka no ukukupikwapo.

Ifisabwa nafyo pamopene ne misalu fifwile ukusanfiwa bwino mumenshi yabusaka elyo ta mulalya pamopene na umwakusungila amenshi.

Ukuchingililako iflimwa mumabala pakuti file kula bwino, kutichawama mulepupamo lime pakuchefyanyako ulubwe mumushili.



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Ukufyaya inshila iya ku bwesheshamo umubela wa menshi panuma yakupimwa munchende ya Ndola

Inchende yaku Kaniki

Kaniki ninchende yapalama mupepi inenchende ya Ndola, umwikala abantu imyanda ibili amakakumi chinelubali elyo na basano. Amenshi ya kunwa yantu ba bomfya yantu bemba mufishima ifipi elyo na mumilonga. Elyo nalebomba kuchifulo ichi mu 2013 abekashi abengi bale ilishanya pamulandu wachena chamenshi, ukuti tachaba bwino.

Ifyafumine mukupimwa kwamenshi

Ifyafumine mukupimwa kwa ayamenshi fyakuti yasankana na utunputawishya twa ulubwe (aliminium), ichishasuminishiwa kunpendwa ya lubwe iyifwaikwa ukusangwa mumenshi ya kunwa ichipimo cintu akabungwe ka World Health ka pima. Elyo muchishima na mumulonga mwasangilwe ubusali (utushishi).

Ukwinga fuma uku koweshiwa kwamenshi

Ulubwe lwapangwafye nalesa umwine talwinga pangwa namuntu iyo. Lusangwa mumenshi icho lusendwa na mulamba wanfula uyo uuya mukuponesha mufishima elyo na mu milonga ya menshi. Elyo ututwine utumputawisha utwalubwe abantu balanwina kumo mumenshi. Ifyo ifinga leta ubwafya kubumi bwamuntu.. Limo tekunya fye mumenshi lelo nokupemafye ululwine ulukungu lwa ulubwe nangu utumputawisha twa ulubwe ukwikata kunkanda yamuntu.. Utushishi tufuma mumala ya muntu nangu inama iya kwata umulopa uwakaba. Utushishi tusendwa ukupitila mumafisho (amafi)

Ifingafuma mukubomfya amenshi ayakwete utunputawishya twa ulubwe na utushishi

Nga chakuti utunputawishya twa ulubwe twa nwika panshitantali, kuti chaleta ubwafya kubumi bwa muntu. Kuti cha onaula bongo bongo ya muntu, ichilafi, ukunaka, ulukanko, ukuonaula amabo, infyo na ameno, elyo nefilonda mumala. Kabili utumputawisha twa ulubwe ngatwaikala mumushili kuti twa lenga ifilimwa ukukana kula bwino icho imishila ilafilwa ukutinta amenshi ne ifilyo. Kabili ututwine tushishi nga twasangwa mumenshi yakunwa kuti twaleta ubulwele bwa ku polomia no ukuluka na hepatitis A. Elyo utushishi tulalenga umwela ukuchepa kabili amenshi mufishima na mumilonga ukulanunka.

Ukwinga sangwa amenshi ayasuma

Mukutampilapofye umulonga walikwata amenshi ayasuma ukuchila ichishima ichipi, icho muchishima ichipi emwasangilwe utumputawisa twalubwe.

Ukupokololako abantu kuli ubu ubusanso amenshi yafwile yafuma mwilibwe lyapanshi sana ilyachishima ukuchila mufishima ifipi ne imilonga pantu mulengila ifyakukowesha amenshi elyo bala posaposa mo ubusali.

Appendix H: Presentation Notes

Kabushi area

In 2013 a study was conducted in Ndola by Elizabeth Liddle about the state of water quality, challenges to provision and associated water development considerations. Many communities were studied in Ndola, including Kabushi, which is a high-density planned township with about 12,094 residents. Water for domestic needs is from shallow wells, the Kafubu River, hand pumps or boreholes and taps in households supplied by the water utility company Kafubu Water and Sewerage Company.

Figures showing the shallow well and Kafubu River where water samples were drawn. Source: Liddle, 2014.

Water quality results

Water quality results revealed that the Kafubu River had high levels of aluminium, iron and faecal coliforms, while the shallow well had a high faecal coliform level (i.e. bacteria). These pollutants were over the maximum acceptable value of both WHO and USEPA, as shown in the table.

Kabushi	*Shallow well*	*Kafubu River*	*WHO/USEPA*	*Adverse effect*	*Key concern*
Aluminium	42 µg/l	262 µg/l	90 µg/l, 50 µg/l	Alzheimer's and discoloration	☹
Barium	50 µg/l	77 µg/l	2,000 µg/l	Increased blood pressure	☺
Chromium	10 µg/l	9 µg/l	50 µg/l	Lung cancer	☺
Copper	1 µg/l	6 µg/l	1,000 µg/l	Stomach pain, liver/kidney damage, metallic taste, staining	☺
Iron	34 µg/l	468 µg/l	300 µg/l	Metallic taste, staining	☹
Manganese	3 µg/l	39 µg/l	400 µg/l, 100 µg/l	Neurological problems, staining, metallic taste	☺
Strontium	39 µg/l	210 µg/l	4,000 µg/l	Development problems in infants	☺
Zinc	21 µg/l	4 µg/l	3,000 µg/l, 5,000 µg/l	Stomach pain, nausea, protein metabolism disruption, damage to pancreas	☺
Faecal coliforms	11 CFU/ 100 ml	127 CFU/ 100 ml	0 CFU/100 ml	Indicator of possible harmful bacteria	☹
Key ☹	Polluted water (contaminant above maximum acceptable value)				
☺	Safer water for domestic use (contaminant below maximum acceptable value)				

Probable source of pollutants

Aluminium and iron are abundant elements that occur naturally in the Earth's crust. After rainfall aluminium and iron particles in the environment enter waterways and wells via runoff. These particles can be taken up by humans through the mouth or nose or contact with the skin. Bacteria originates from intestinal tracts of warm-blooded animals; it is released into the environment through deposition of faecal material.

Possible effects of pollutants

Long-time exposure or uptake of significant concentrations of a water-soluble form of aluminium can lead to serious health effects, such as damage to the central nervous system, Alzheimer's, severe trembling, liver dysfunction, kidney dysfunction, ulcers, and dental cavities. Iron gives water an undesirable metallic taste and can cause conjunctivitis, choroiditis, and retinitis. High concentrations of aluminium cause stunted roots in plants which lead to a decline in crop yields as the roots' ability to absorb water and nutrients is affected. High levels of iron can cause discoloration of plants.

Bacteria such as *E. coli* cause waterborne diseases such as dysentery, typhoid, cholera, and hepatitis A. In the environment bacteria may reduce the oxygen level, causing bad smells.

Safe source of water

Generally, the wells, pumps, boreholes and taps are a safe source of water for domestic use. This is because water from these sources is protected or covered from exposure to pollutants.

Treating water for consumption and crop production

Bacteria can be killed by boiling of water or addition of chlorine before drinking. It can be prevented from entering shallow wells through runoff by protecting and covering the wells. Fruits and vegetables must be washed in clean water before eating to avoid uptake of bacteria. To produce better crop yields application of lime to the soil eliminates aluminium and iron toxicity.

Nkwazi area

In 2013 a study was conducted in Ndola by Elizabeth Liddle about the state of water quality, challenges to provision and associated water development considerations. Many communities were studied in Ndola, including Nkwazi, a high-density informal community with about 21,402 people. Water for domestic use is extracted from shallow wells, the stream and kiosks set up by the Kafubu Water and Sewerage Company.

Figures showing the stream and shallow well where samples were taken from. Source: Liddle, 2014.

Water quality results

After analysis of samples, results revealed that the shallow well and the stream had high levels of aluminium, iron, manganese and faecal coliforms which were over the maximum acceptable values. The shallow well had extremely high levels of aluminium and iron. The level of manganese in the stream was above the USEPA maximum acceptable value but the shallow well had a concentration slightly below the WHO value. The stream had a higher level of faecal coliforms compared to the shallow well as, shown in the table.

Nkwaki	*Shallow well*	*Stream*	*WHO/USEPA*	*Adverse effect*	*Key concern*
Aluminium	444 µg/l	191 µg/l	90 µg/l, 50 µg/l	Alzheimer's and discoloration	☹
Barium	145 µg/l	219 µg/l	2,000 µg/l	Increased blood pressure	☺
Chromium	0.7 µg/l	0.7 µg/l	50 µg/l	Lung cancer	☺
Copper	1 µg/l	2.4 µg/l	1,000 µg/l	Stomach pain, liver/kidney damage, metallic taste, staining	☺
Iron	737 µg/l	423 µg/l	300 µg/l	Metallic taste, staining	☹
Manganese	87 µg/l	183 µg/l	400 µg/l, / 100 µg/l	Neurological problems, staining, metallic taste	☹
Strontium	166 µg/l	177 µg/l	4,000 µg/l	Development problems in infants	☺
Zinc	9 µg/l	27 µg/l	3,000 µg/l, 5,000 µg/l	Stomach pain, nausea, protein metabolism disruption, damage to pancreas	☺
Faecal coliforms	50 CFU/ 100 ml	2,200 CFU/ 100 ml	0 CFU/100 ml	Indicator of possible harmful bacteria	☹

Key		
	☹	Polluted water (contaminant above maximum acceptable value)
	☹	unsafe water for domestic use (contaminant above USEPA maximum acceptable value)
	☺	Safer water for domestic use (contaminant below maximum acceptable value)

Probable source of pollutants

Aluminium, iron and manganese are abundant elements that occur naturally in the soil or Earth's crust. After rainfall particles of these elements in the environment enter waterways and wells via runoff. These particles can be taken up by humans through the mouth or nose or

contact with the skin. Bacteria originates from intestinal tracts of warm-blooded animals; it is released into the environment through deposition of faecal material.

Possible effects of pollutants

Long-time exposure or uptake of significant concentrations of water-soluble forms of aluminium can lead to serious health effects, such as damage to the central nervous system, Alzheimer's, and dysfunction of the liver and bladder. Manganese can cause neurological problems, staining and metallic taste of water. Iron can give water an undesirable metallic taste and can cause eye diseases. High concentrations of aluminium can cause stunted roots in plants which lead to a decline in crop yields as the roots' ability to absorb water and nutrients is affected. Toxic levels of iron in soils can cause discolouration of plants while manganese can cause brown spots on leaves and leaf withering.

Bacteria such as *E. coli* cause waterborne diseases such as dysentery, typhoid, cholera and hepatitis A. In the environment bacteria may reduce the oxygen level, causing bad smells.

Safe source of water

Overall the shallow well and stream are not safe sources of water for domestic use because the shallow well had high levels of aluminium and iron while the stream had extremely high levels of manganese and bacteria. To protect people from exposure to these pollutants water should be drawn from deeper-confined aquifers, e.g., boreholes and water kiosks, as they contain safer water for drinking, as opposed to shallow wells or open streams, which are susceptible to pollution.

Treating water for consumption and crop production

Bacteria can be killed by boiling water or addition of chlorine before drinking. Bacteria can be prevented from entering shallow wells through runoff by protecting and covering the wells. Fruits and vegetables must be washed in clean water before eating to avoid uptake of bacteria. To produce better crop yields application of lime to the soil eliminates aluminium toxicity, increases soil pH, and as a result eliminates manganese and iron toxicity.

Kaniki area

In 2013 a study was conducted in Ndola by Elizabeth Liddle about the state of water quality, challenges to provision and associated water development considerations. Many communities were studied in Ndola, including Kaniki, a low-density informal rural community with about 275 people. The water for domestic use in Kaniki is drawn from a hand-dug shallow well and the stream.

Figures showing the hand-dug shallow well and the stream where samples were taken from. Source: Liddle, 2014.

Water quality results

During field work in this community, many people complained about the taste of the water, which they considered as unacceptable. The water quality results revealved a very high concentration of aluminium in the shallow well which was over the maximum acceptable values of both WHO and USEPA. The well and stream also had high concentrations of faecal coliforms, as shown in the table.

Kaniki	*Shallow well*	*Stream*	*WHO/USEPA*	*Adverse effect*	*Key concern*
Aluminium	245 µg/l	7 µg/l	90 µg/l, 50 µg/l	Alzheimer's and discoloration	☹
Barium	91 µg/l	412 µg/l	2,000 µg/l	Increased blood pressure	☺
Chromium	0.7 µg/l	0.7 µg/l	50 µg/l	Lung cancer	☺
Copper	39 µg/l	5 µg/l	n/a, 1,000 µg/l	Stomach pain, liver/kidney damage, metallic taste, staining	☺
Iron	11 µg/l	86 µg/l	300 µg/l	Metallic taste, staining	☺
Manganese	5 µg/l	14 µg/l	400 µg/l, 100 µg/l	Neurological problems, staining, metallic taste	☺
Strontium	81 µg/l	66 µg/l	n/a, 4,000 µg/l	Development problems in infants	☺
Zinc	2 µg/l	2 µg/l	3,000 µg/l, 5,000 µg/l	Stomach pain, nausea, protein metabolism disruption, damage to pancreas	☺
Faecal coliforms	30 CFU/ 100 ml	201 CFU/ 100 ml	0 CFU/100 ml	Indicator of possible harmful bacteria	☹
Key	☹	Polluted water (contaminant above maximum acceptable value)			
	☺	Safe water for domestic use (contaminant slightly below maximum acceptable value)			
	☺	Safer water for domestic use (contaminant below maximum acceptable value)			

Probable source of pollutants

Aluminium is an abundant element that occurs naturally in the Earth's crust. It is very rare in its free form. After rainfall aluminium particles in the environment enter waterways and wells via runoff. These particles can be taken up by humans through the mouth or nose or contact to the skin. Bacteria originates from intestinal tracts of warm-blooded animals and is released into the environment through deposition of faecal material.

Possible effects of pollutants

Long-term exposure or uptake of significant concentrations of water-soluble forms of aluminium can lead to serious health effects, such as damage to the central nervous system, dementia, loss of memory, laziness, severe trembling, liver dysfunction, kidney dysfunction, ulcers and dental cavities. High concentrations also cause stunted roots in plants which lead to a decline in crop yields as the roots' ability to absorb water and nutrients is affected.

Bacteria such as *E. coli* cause waterborne diseases such as dysentery, typhoid, cholera, viral and bacterial gastroenteritis and hepatitis A. In the environment bacteria may reduce the oxygen level, causing bad smells.

Safe source of water

The stream is a safer source of water for domestic use because the shallow well had a high concentration of aluminium. To protect people from exposure to aluminium, water should be drawn from deeper-confined aquifers, for example boreholes, as they contain safer water for drinking, rather than shallow wells or open streams, which are susceptible to pollution.

Treating water for consumption and crop production

Bacteria can be killed by boiling of water or addition of chlorine before drinking. It can be prevented from entering shallow wells through runoff by protecting and covering the wells. Fruits and vegetables must be washed in clean water before eating to avoid uptake of bacteria. To produce better crop yields application of lime to the soil eliminates aluminium toxicity.

Appendix I: Discussion Notes

Same focus group discussion procedure for Kabushi, Nkwazi and Kaniki communities

Participants discuss the following issues, and the same figures used with the brochure, presentation and video methods should be provided to individuals.

Tell the participants the water quality results from Liddle's study in 2013.

Discuss the probable source of pollutants.

What are the possible effects of pollutants on human health and crops?

Discuss what can be done to prevent pollution of water sources.

The link to the video with figures used in each method during the focus group meetings is https://youtu.be/rxixkCoPhBk